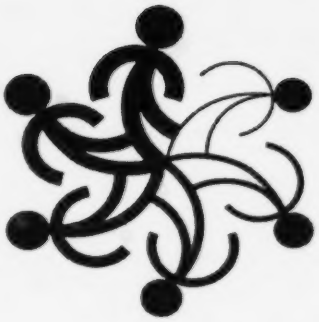
Catalogue no. 89-599-M — No. 005
ISSN: 1712-3070
ISBN: 978-1-100-10337-2

Research Paper

Children and Youth Research Paper Series

The Children of Older First-time Mothers in Canada : Their Health and Development



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The Children of Older First-time Mothers in Canada: Their Health and Development

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September 2008

Catalogue no. 89-599-M, no. 005
ISSN: 1712-3070
ISBN: 978-1-100-10337-2

Frequency: Occasional

Ottawa

Cette publication est disponible en français sur demande (nº 89-599-M au catalogue).

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

Acknowledgements

The authors wish to thank all those involved in the development and production of the National Longitudinal Survey of Children and Youth at Statistics Canada (STC) and Human Resources and Social Development Canada (HRSDC).

The assistance of many people was invaluable to the production of this research paper. Thanks go to those in Special Surveys Division and Health Information and Research Division at STC, along with those in HRSDC who provided helpful feedback and suggestions. A special thank you is extended to Bernie Edwards, Sylvie LeBlanc and Chi Mai Pham for their indispensable help in preparing the manuscript for publication.

Symbol legend

.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
p	preliminary
r	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
E	use with caution
F	too unreliable to be published

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1. Introduction

In Canada, it is increasingly common for women to delay childbearing. Not only are more women over thirty giving birth, but the proportion of first births occurring among women over thirty has been increasing steadily over the past 20 years.

It is important to understand the possible implications of these trends for human health and development. While many studies have examined the pregnancy and health-related outcomes of late childbearing for women, less is known concerning the potential consequences for their children.

The purpose of this study is to help fill this gap. Using data from the National Longitudinal Survey of Children and Youth (NLSCY), this study examined the relationship between late childbearing among first-time mothers and three facets of children's development: (i) physical health and development, (ii) behaviour, and (iii) cognitive development.

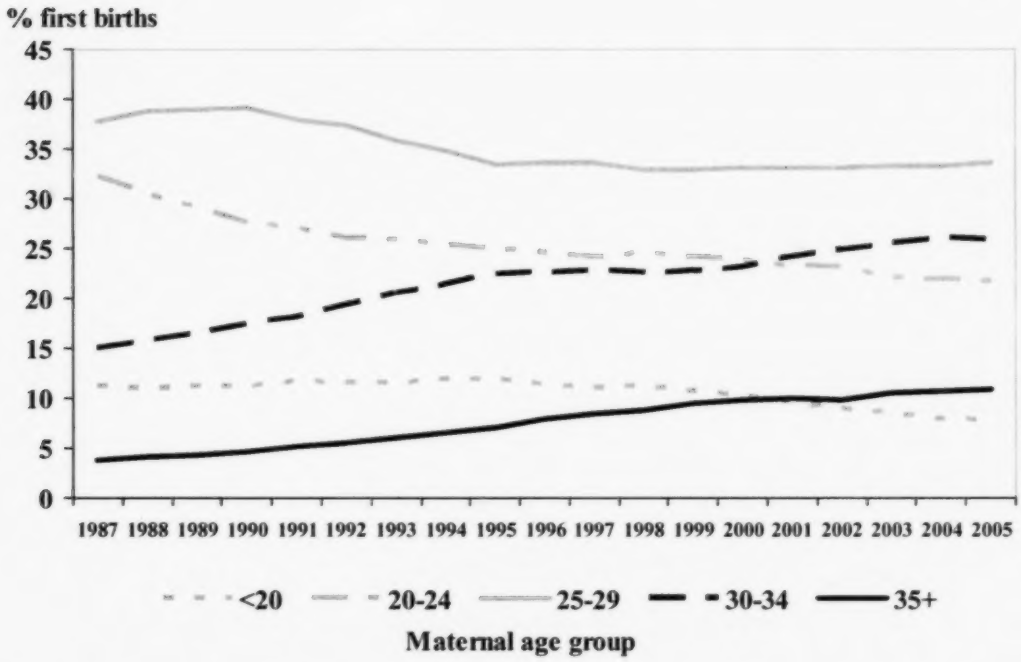
The report begins with a definition of "late childbearing", followed by a profile of the characteristics of the first-born children included in the study and a description of the variables of interest. Subsequent sections address the relationship between the age of the mother at the child's birth and three facets of children's development.

2. Background

Since 2000, the fertility rate in Canada has been on the rise, reversing a trend of declining fertility that began in the early 1990s. The total fertility rate in 2005 was 1.54 children per woman, which was a significant increase from the low rate of 1.48 set in 2000 (Statistics Canada, 2007). This rise in the fertility rate has been primarily attributed to increased fertility among Canadian women in their thirties (Statistics Canada, 2007).

Many women are also postponing childbearing until later ages. Over the past 20 years, Canada has seen a substantial increase in the proportion of first births occurring among women age 35 and older. While only 4% of first births in 1987 occurred among women aged 35 and up, by 2005 the rate had nearly tripled at 11% (Figure 1). Over this same period, the proportion of first births occurring among women in their early thirties also increased, from 15% in 1987 to 26% in 2005.

Figure 1 Percentage distribution of first births in Canada by maternal age group, 1987 to 2005



Source: Statistics Canada, 1987 through 2005 Vital Statistics Birth Data, Canada.

The trend towards older motherhood is not unique to Canada. The mean age of women having their first child in the United States rose from 21.4 in 1970 to 24.9 in 2000 (Matthews & Hamilton, 2002). Nevertheless, Canadian women are more likely to have their first child in their thirties than their American counterparts. In 2004, more than a third (35%) of births to Canadian women in their thirties were first births, while the proportion in the United States was only 27% (Statistics Canada, 2006).

Risks of advanced maternal age

Advanced maternal age is associated with a number of risks. Older mothers are at increased risk of fetal loss such as miscarriage or stillbirth (de La Rochebrochard & Thonneau, 2002; Fretts, Schmittdiel, McLean, Usher, & Goldman, 1995; Nybo Andersen, Wohlfahrt, Christens, Olsen, & Melbye, 2000), decreased ability to conceive (Broekmans, Knauff, te Velde, Macklon, & Fauser, 2007; Gougeon, 2005; Rizzi, Rossina, & Colombo, 2005) and complications of pregnancy (Astolfi & Zonta, 2002; MacNab, Macdonald, & Tuk, 1997; Prysak, Lorenz, & Kisly, 1995; Ziadeh & Yahaya, 2001). There are also increased risks of birth defects (Reefhuis & Honein 2004) and birth complications (Astolfi & Zonta, 2002; MacNab et al., 1997; Prysak et al., 1995; Ziadeh & Yahaya, 2001). However, less is known about the relationship between advanced maternal age and children's development.

Among studies that have examined maternal age and children's outcomes, the majority have focused on the health and development of children of teenaged mothers (Levine, Pollack, & Comfort, 2001; Pogarsky, Thornberry, & Lizotte, 2006; Spieker, Larson, Lewis, Keller, & Gilchrist, 2006). Findings from such studies suggest that, in early childhood, children of teenaged mothers tend to have higher levels of behaviour problems, while cognitive and academic problems become pronounced as they enter adolescence (Brooks-Gunn & Furstenberg, 1986). Furthermore, children of teenaged mothers are more likely than other youth to become teenaged parents themselves (SmithBattle & Leonard, 2006; SmithBattle, 2007). In most such studies, maternal age is characterized as *teenaged* or *not teenaged*, and is not examined as a continuum.

Among the studies that have examined advanced maternal age, Fergusson and Woodward (1999) found that the risks of youth's educational underachievement, involvement in crime, substance misuse and mental health problems at age 18 decreased with increasing maternal age. This study also found that, while increased maternal age was associated with more nurturing and stable home environments, controlling for such factors did not fully account for the effect of maternal age on children's later outcomes. However, Fergusson and Woodward did not distinguish between maternal age at the birth of a specific child (which was the measure in the Fergusson and Woodward study) and maternal age at first birth. Other studies have shown that a child's behavioural and cognitive development is better predicted by mother's age at first birth than age at the child's birth (Lopez Turley, 2003). This distinction is important because early age at first childbirth may have an impact on the life opportunities available to young mothers (SmithBattle, 2007), thereby affecting the well-being and development of all subsequent children, regardless of the woman's age at future births.

3. Objectives

This study used data from the Canadian National Longitudinal Survey of Children and Youth (NLSCY) to examine the relationship between late childbearing among first-time mothers and three facets of child development: (i) physical health and development, (ii) behaviour, and (iii) cognitive development.

4. Methods

Participants

The children in this study participated in the National Longitudinal Survey of Children and Youth (NLSCY). The NLSCY is a long-term study of Canadian children that collects information on a wide range of topics including the social, emotional, behavioural, physical and cognitive development of children from birth to early adulthood.

At each collection cycle of the NLSCY, a new cohort of 0 and 1-year-olds is added and followed every two years until the ages of 4 and 5. For this study, children who were 0 and 1 years old in Cycle 3 (1998), Cycle 4 (2000), Cycle 5 (2002) and Cycle 6 (2004) were selected and pooled together. From this pooled sample, only those children who were first-born and whose biological mother was the person interviewed at each cycle were retained for this study. This resulted in a final sample of 3,382 children who represented about 556,000 children in the Canadian population. For more information about the NLSCY and the sample selection process for this study, see Appendix A.

Explanatory variables

In this study of children's developmental outcomes, it was important to take into account the influence of various socio-demographic, behavioural and developmentally-related characteristics of the children and their mothers. A full description of these explanatory variables is provided in Appendix B, with a summary provided below. Note that all of these variables were based on data reported by the mother.

Maternal age group
For the present discussion, late childbearing is defined as giving birth to a first child at or after age 35. For all analyses, the reference group is women who first gave birth between the ages of 25 and 29 years.

However, to facilitate comparison with data from other studies, results are presented for other maternal age groups. The following terms are used in this report to define the groups of women and children:

Teenaged mother = Woman who was under age 20 when she had her first child
Young mother = Woman who was aged 20 to 24 when she had her first child
Reference mother = Woman who was aged 25 to 29 when she had her first child
Middle mother = Woman who was aged 30 to 34 when she had her first child
Older mother = Woman who was aged 35 or older when she had her first child

Socio-demographic characteristics
Three socio-demographic characteristics were examined in this study: the mother's educational attainment (high school diploma or less versus more education), the level of household income (low-income versus not low-income), and the number of parents in the household (single-parent

versus dual-parent household). All characteristics were assessed at the first interview when the child was aged 0 to 1.

Perinatal and postnatal measures
Variables related to the birth of the child included method of delivery, gestational age, and birth weight. These variables were assessed for all children at the first interview and were dichotomized to identify those who were born by caesarean, who were born preterm (258 days gestation or less), or who were born at low birth weight (2499 grams or less).

Mothers were asked about duration of breastfeeding, and children were grouped into three categories: children not breastfed at all, children breastfed for 6 months or less, and children breastfed for more than 6 months.

Maternal health
The two indicators of maternal health included in this study were asthma and depressive symptoms. At first interview, women were asked whether they had been diagnosed with asthma by a health professional. Depressive symptoms were based on women's reports of the occurrence and severity of symptoms in the previous week, and were assessed at the same time as the selected outcome.

Parenting practices and family functioning
Mothers were asked about parenting practices and family functioning. This study examined positive parenting practices, ineffective parenting practices and a measure of overall family functioning. Each of these was measured at the same time as the selected outcome.

Daily reading to the child
Based on mother's reports, an indicator of whether the child was read to daily at ages 4 to 5 was included in certain analyses.

Outcome variables

A series of variables in the NLSCY were selected to characterize children's physical, behavioural, and cognitive development across early childhood. A short description of each is given below. For a full description of these outcome variables and their associated items, see Appendix C.

Children's physical health and development
Physical health and development included whether the child received specialized care following his/her birth, the child's general health status (excellent/very good or good/fair/poor) and whether the child had been diagnosed with asthma. Receipt of specialized care at birth was assessed at the first interview, while children's general health and asthma diagnosis were assessed at all ages.

The attainment of several developmental milestones was examined, along with the child's motor and social skill development at ages 0 to 1 and 2 to 3. All of these outcomes were based on maternal reports.

Problem and positive behaviours

Indicators of physical aggression, emotional disorder and anxiety, hyperactivity and inattention, and positive behaviour were examined in this study. All were measured at ages 2 to 3 and 4 to 5, with the exception of positive behaviour which was measured at ages 4 to 5 only. All behavioural outcomes were based on maternal reports.

Cognitive development

Three direct assessments of cognitive ability were administered to children ages 4 to 5. The Peabody Picture Vocabulary Test – Revised (PPVT-R) was used to assess receptive vocabulary skills (Dunn & Dunn, 1981). Children's number knowledge was evaluated using the Number Knowledge Assessment instrument. The 'Who Am I?' instrument was used to assess copying and symbol use (DeLemos, 2002).

5. Data analysis

For each outcome measure, means or proportions were generated overall and by maternal age group. In all analyses, children whose mothers were aged 25 to 29 at the child's birth formed the reference category.

Multivariate regression models were generated for each outcome. Included in each model was the mother's age at the child's birth, a group of socio-demographic characteristics, and selected maternal characteristics or behaviours thought to be associated with the outcome of interest. Because respondents were pooled across several cycles of the NLSCY, a control variable indicating cycle of entry to the NLSCY was also included in each model (although values for this estimate are not given herein).

Logistic models were fit to dichotomous outcomes, while linear models were fit to continuous outcomes. All analyses were conducted using SAS-callable SUDAAN. To account for the complex survey design of the NLSCY, an appropriate survey weight was used for all estimates, and bootstrap weights were used to produce variance estimates.

In the NLSCY, the child is the unit of analysis. Therefore, throughout this paper, any information relating to the mother or the household should be interpreted as a characteristic of the *child*. For example, when referring to mothers who suffered from gestational diabetes, the estimate reflects the percentage of *children* whose mothers suffered from the condition, not the percentage of mothers with the condition. While this distinction may not always be made explicitly in the text, the reader should be aware that it is always implied.

6. Children of older first-time mothers

Socio-demographic characteristics

Based on this sample from the NLSCY, about 11% of first-born children were born to older mothers (Table 1). A further 24% of children were born to middle mothers, 34% to reference mothers, 23% to young mothers, and 8% to teenaged mothers.

Children of older mothers had a similar socio-demographic profile as with children born to reference mothers (Table 1). Children born to teenaged and young mothers, however, were significantly more likely to be in single-mother and low-income households, and to have mothers with no more than a high school education compared to children of reference mothers.

Table 1 Characteristics of children, by maternal age group

	Overall	Maternal Age Group				
		Teenaged (younger than 20)	Young (20 to 24)	Reference (25 to 29)	Middle (30 to 34)	Older (35 or older)
Sample (n=3,382), %	100.0	7.5	23.4	34.5	23.9	10.8
Socio-demographic characteristics						
Mother's education is high school or less, %	22.5	74.0***	38.0***	12.9	9.3	12.9
Low-income household, %	18.5	64.4***	32.0***	10.6	6.1*	11.8
Mother is single parent, %	13.7	47.9***	25.7***	5.7	6.1	6.3
Prenatal						
Mother had gestational diabetes, %	6.0	2.7*	5.6	5.5	6.0	10.2
Mother had gestational hypertension, %	13.7	13.0	11.9	13.1	12.8	22.5**
Mother smoked throughout pregnancy, %	11.7	28.9***	17.8***	9.6	6.0	6.9
Perinatal						
Caesarean delivery, %	24.3	18.1	18.0*	23.3	26.9	39.6***
Preterm birth, %	12.1	9.6	9.6	11.2	14.1	17.4*
Low birth weight, %	7.5	6.9	4.9	6.4	9.5	11.9
Duration of breastfeeding						
Never, %	13.9	27.0***	15.7	12.1	12.7	9.3
6 months or less, %	47.4	54.2	53.9	52.5	37.1***	35.0***
More than 6 months, %	28.7	14.5**	20.1*	26.0	38.8***	42.8***
Duration unknown, %	10.1	4.3	10.3	9.3	11.4	12.9

*p<.05; **p<.01; ***p<.001

Note: Comparisons by maternal age are made against children of reference mothers.

Prenatal and birth-related characteristics

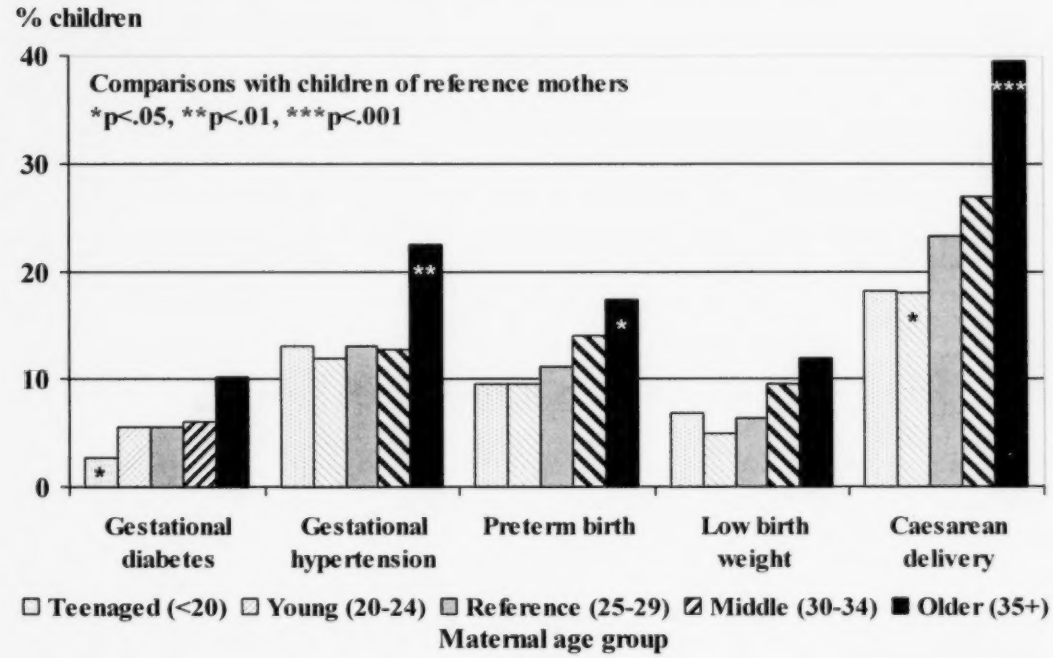
Children of older mothers tended to experience more prenatal and birth-related complications than children of reference mothers (Table 1). Children of older mothers were more likely to have a mother who suffered from gestational hypertension and to be born preterm (Figure 2). A greater proportion of children of older mothers were also delivery by caesarean.

These findings are supported by numerous studies of older mothers that have found increased risk of gestational hypertension (Carolan, 2003; Prysak et al., 1995; Tough, Tofflemire, Benzies, Fraser-Lee, & Newburn-Cook, 2007), and preterm birth (Carolan, 2003; Tough et al., 2006; Heck, Schoendorf, Ventura, & Kiely, 1997; Ziadeh & Yahaya, 2001; Tough et al., 2007) and caesarean delivery (Carolan, 2003; Heck et al., 1997; Ziadeh & Yahaya, 2001; Prysak et al., 1995; Tough et al., 2007).

NLSCY data indicated that about 7% of children of older mothers were exposed to maternal smoking throughout the pregnancy (Table 1). While this proportion was significantly lower than that among children of teenaged mothers (29%), it did not differ from that among children of reference mothers (10%).

Children of older mothers were significantly more likely to have been breastfed and breastfed longer compared to children of reference mothers. Forty-three percent (43%) of children of older mothers were breastfed for more than 6 months compared to 26% of children of reference mothers (Table 1). These rates were significantly lower among children of teenaged (15%) and young mothers (20%).

Figure 2 Prenatal and birth-related risk factors, by maternal age group



Source: Statistics Canada, National Longitudinal Survey of Children and Youth, cycles 3 through 6.

7. Children's physical health and development

Children who received special care at birth

When women were first interviewed in the NLSCY, they were asked about their pregnancy and birth experiences, including the health of their child at birth. One measure of the child's health was whether the child received any sort of specialized care at birth. Overall, 21% of children required some form of specialized care at birth (Table 2). Of these children, 39% spent time in the intensive care unit and 20% were put on ventilation or oxygen. On average, children who received specialized care were in this type of care for 7.3 days, although the median was much lower at 2.0 days.

Table 2 Measures of children's health at birth, by maternal age group

	Overall	Maternal Age Group				
		Teen-aged (younger than 20)	Young (20 to 24)	Reference (25 to 29)	Middle (30 to 34)	Older (35 or older)
Child required special care at birth, % (n=3,279)	20.5	22.8	19.5	18.6	20.9	25.9
Type of care received[a] (n=644)						
Intensive care, %	39.4	42.7	39.9	38.8	38.5	39.7
Oxygen/ventilation, %	19.8	23.5	17.5	22.4	20.6	13.9
Transferred to special hospital, %	6.2	x	6.2	4.1	8.9	8.6
Other, %	47.6	52.8	54.3	45.0	39.4	54.4
Days in specialized care (n=642)						
Mean (se)	7.3(0.7)	7.1[E] (1.4)	6.5[E] (1.1)	6.3(1.0)	8.1[E] (1.5)	9.7[E] (2.4)
Median (se)	2.0(0.2)	F	1.3[E] (0.4)	1.8(0.3)	2.1[E] (0.5)	2.5[E] (0.6)

x suppressed to meet the confidentiality requirements of the *Statistics Act*
[E] use with caution
F too unreliable to be published
[a] measured only for children who received specialized care at birth
*p<.05; **p<.01; ***p<.001
Note:
Comparisons by maternal age are made against children of reference mothers.

Maternal age. More than one in four (26%) children of older mothers required special medical care when they were born, but this did not differ significantly from children of reference mothers (19%). Among children who required specialized care, there was no difference by maternal age group in the type of care that was received or the length of time spent in specialized care (Table 2).

In multivariate analyses controlling for socio-demographic and birth-related characteristics (Table 3), children of older mothers were as likely as children of reference mothers to have required specialized care at birth.

Other factors. The only variables to be significantly associated with receiving specialized care at birth in the multivariate model were gestational age and weight. Children who were born preterm, whether they were of low birth weight, were significantly more likely to have required specialized medical care at birth than children who were not born prematurely (Table 3).

Table 3 Receiving special care at birth: Odds ratios (ORs) and 95% confidence intervals (95% CIs) from multivariate logistic models

Characteristics	OR	95% CI
Maternal age group		
Teenaged (younger than 20)	1.29	(0.72, 2.34)
Young (ages 20 to 24)	1.05	(0.74, 1.49)
Reference (ages 25 to 29; Ref.)	1.00	...
Middle (ages 30 to 34)	1.05	(0.73, 1.50)
Older (ages 35 or older)	1.23	(0.78, 1.95)
Socio-demographic characteristics		
Child is male (Ref. Female)	1.11	(0.85, 1.46)
Low-income (Ref. Not low-income)	1.01	(0.62, 1.66)
High school graduate or less (Ref. More than high school education)	1.04	(0.74, 1.46)
Single-parent household (Ref. Dual-parent household)	1.19	(0.71, 1.99)
Other characteristics		
Caesarean delivery (Ref. Vaginal delivery)	1.23	(0.91, 1.66)
Birth term and weight		
Not preterm (Ref.)	1.00	...
Preterm, not low birth weight	4.55***	(2.95, 7.01)
Preterm, low birth weight	14.56***	(7.65, 27.69)

... not applicable
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Children's health in early childhood (ages 0 through 5)

At every cycle, mothers were asked about the health of their child. The majority of children in this study were reported by their mothers as being in excellent or very good health throughout early childhood: 93% at ages 0 to 1, 92% at ages 2 to 3 and 91% at ages 4 to 5 (Table 4). Because children are generally in good health, they do not exhibit many chronic conditions. However, asthma is a very prevalent chronic condition among children (Akinbami & Schoendorf, 2002; Asher et al., 2006; Mannino, Homa, Akinbami, Moorman, Gwynn, & Redd, 2002; Millar & Hill, 1998). Among the first-born children in this study, the prevalence of doctor-diagnosed asthma increased as children grew older, from 4% among 0 to 1-year-olds to nearly 16% four years later among 4- to 5-year-olds.

Table 4 Physical health measures by child's age, by maternal age group

		Maternal Age Group				
	Overall	Teen-aged (younger than 20)	Young (20 to 24)	Reference (25 to 29)	Middle (30 to 34)	Older (35 or older)
General health is excellent or very good, %						
Ages 0 to 1 (n=3,380)	92.8	86.6*	91.5	93.9	94.1	93.2
Ages 2 to 3 (n=2,350)	92.3	88.9	91.9	91.8	93.3	94.7
Ages 4 to 5 (n=1,691)	90.9	85.2	87.2	90.7	96.7**	92.8
Diagnosed with asthma, %						
Ages 0 to 1 (n=3,376)	3.7	4.9	4.0	3.5	3.2	3.6
Ages 2 to 3 (n=2,347)	10.2	8.4	9.7	10.2	13.1	6.3
Ages 4 to 5 (n=1,691)	15.7	12.7	16.5	14.8	18.7	12.9

*p<.05; **p<.01; ***p<.001

Note:

Comparisons by maternal age are made against the children of reference mothers.

Excellent or very good general health

Maternal age. Overall, the general health of children born to older mothers did not differ from that of children of reference mothers (Table 4). Children of teenaged mothers were significantly less likely than children of reference mothers to be in excellent or very good health when they were ages 0 to 1. Conversely, children of middle mothers were significantly more likely to be in excellent or very good health when they were 4 to 5 years old, compared to children of reference mothers.

After controlling for the effects of other characteristics, maternal age was not significantly associated with children's general health at any age. The exception was that children born to middle mothers remained significantly more likely than children of reference mothers to be in excellent or very good health at ages 4 to 5 (Table 5).

Other factors. Few other characteristics showed significant associations with children's general health. Children born preterm and at low birth weight were significantly less likely than full-term children to be in excellent or very good health at ages 2 to 3, while children whose mother

had no more than a high school education were significantly less likely to be in excellent or very good health at ages 4 to 5 (Table 5).

Asthma

Maternal age. There were no significant differences between maternal age groups in the proportion of children diagnosed with asthma (Table 4). After adjusting for the effect of socio-demographic factors as well as gestational age, birth weight and duration of breastfeeding (Table 6), maternal age continued to have no association with the diagnosis of asthma among children.

Other factors. From the multivariate models, boys were significantly more likely to be diagnosed with asthma than girls at ages 4 to 5, and children whose mothers had asthma were significantly more likely to receive an asthma diagnosis themselves (Table 6). These findings are consistent with results from other studies of childhood asthma (Garner & Kohen, 2008; Millar & Hill, 1998).

Table 5 General health (excellent or very good vs. good, fair or poor health) by child's age: Odds ratios (ORs) and 95% confidence intervals (95% CIs) from multivariate logistic models

Characteristics	Ages 0 to 1		Ages 2 to 3		Ages 4 to 5	
	OR	95% CI	OR	95% CI	OR	95% CI
Maternal age group						
Teenaged (younger than 20)	0.54	(0.26, 1.10)	0.94	(0.38, 2.34)	0.81	(0.26, 2.49)
Young (ages 20 to 24)	0.73	(0.44, 1.20)	1.30	(0.67, 2.53)	0.93	(0.46, 1.86)
Reference (ages 25 to 29; Ref.)	1.00	...	1.00	...	1.00	...
Middle (ages 30 to 34)	1.02	(0.59, 1.78)	1.22	(0.59, 2.54)	2.87**	(1.33, 6.22)
Older (ages 35 or older)	0.81	(0.38, 1.73)	1.53	(0.65, 3.59)	1.18	(0.46, 3.04)
Socio-demographic characteristics						
Child is male (Ref. Female)	0.90	(0.61, 1.33)	1.11	(0.70, 1.77)	0.77	(0.45, 1.29)
Low-income (Ref. Not low-income)	1.25	(0.69, 2.28)	0.89	(0.41, 1.91)	0.80	(0.33, 1.98)
High school graduate or less (Ref. More than high school education)	0.87	(0.55, 1.36)	0.75	(0.43, 1.31)	0.48*	(0.26, 0.88)
Single-parent household (Ref. Dual-parent household)	0.78	(0.45, 1.38)	0.73	(0.30, 1.79)	1.00	(0.37, 2.67)
Other characteristics						
Duration of breastfeeding						
None (Ref.)	1.00	...	1.00	...	1.00	...
6 months or less	1.37	(0.45, 2.25)	1.18	(0.63, 2.20)	0.76	(0.39, 1.48)
More than 6 months	1.32	(0.74, 2.34)	1.06	(0.50, 2.22)	1.02	(0.48, 2.18)
Birth term and weight						
Not preterm (Ref.)	1.00	...	1.00	...	1.00	...
Preterm, not low birth weight	0.89	(0.40, 1.95)	0.84	(0.18, 3.89)	0.74	(0.14, 3.81)
Preterm, low birth weight	0.55	(0.28, 1.08)	0.27**	(0.10, 0.68)	0.58	(0.20, 1.67)

... not applicable

*p<.05; **p<.01; ***p<.001

Note:

Characteristics measured when child was aged 0 to 1.

All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Table 6 Asthma diagnosis by child's age: Odds ratios (ORs) and 95% confidence intervals (95% CIs) from multivariate logistic models

Characteristics	Ages 0 to 1		Ages 2 to 3		Ages 4 to 5	
	OR	95% CI	OR	95% CI	OR	95% CI
Maternal age group						
Teenaged (younger than 20)	0.92	(0.31, 2.73)	0.59	(0.24, 1.45)	0.56	(0.22, 1.46)
Young (ages 20 to 24)	0.91	(0.40, 2.05)	0.67	(0.36, 1.24)	0.92	(0.50, 1.71)
Reference (ages 25 to 29; Ref.)	1.00	...	1.00	...	1.00	...
Middle (ages 30 to 34)	1.02	(0.48, 2.18)	1.53	(0.92, 2.54)	1.31	(0.71, 2.43)
Older (ages 35 or older)	1.23	(0.34, 4.42)	0.73	(0.35, 1.52)	0.98	(0.46, 2.06)
Socio-demographic characteristics						
Child is male (Ref. Female)	1.02	(0.55, 1.91)	1.48	(0.97, 2.26)	1.95**	(1.26, 3.02)
Low-income (Ref. Not low-income)	0.90	(0.45, 1.78)	0.98	(0.51, 1.91)	0.91	(0.42, 1.96)
High school graduate or less (Ref. More than high school education)	1.05	(0.56, 1.97)	0.88	(0.51, 1.52)	1.27	(0.72, 2.25)
Single-parent household (Ref. Dual-parent)	2.56*	(1.10, 5.98)	2.71*	(1.18, 6.23)	1.94	(0.70, 5.38)
Other characteristics						
Duration of breastfeeding						
None (Ref.)	1.00	...	1.00	...	1.00	...
6 months or less	0.85	(0.37, 1.97)	0.79	(0.43, 1.45)	0.78	(0.42, 1.44)
More than 6 months	0.71	(0.30, 1.69)	0.64	(0.34, 1.21)	0.71	(0.35, 1.44)
Birth term and weight						
Not preterm (Ref.)	1.00	...	1.00	...	1.00	...
Preterm, not low birth weight	2.70	(0.97, 7.51)	1.28	(0.56, 2.94)	0.93	(0.29, 2.96)
Preterm, low birth weight	2.17	(0.71, 6.63)	1.06	(0.22, 5.05)	1.59	(0.39, 6.52)
Mother has asthma	4.63***	(2.55, 8.40)	2.83***	(1.67, 4.79)	3.79***	(2.12, 6.77)

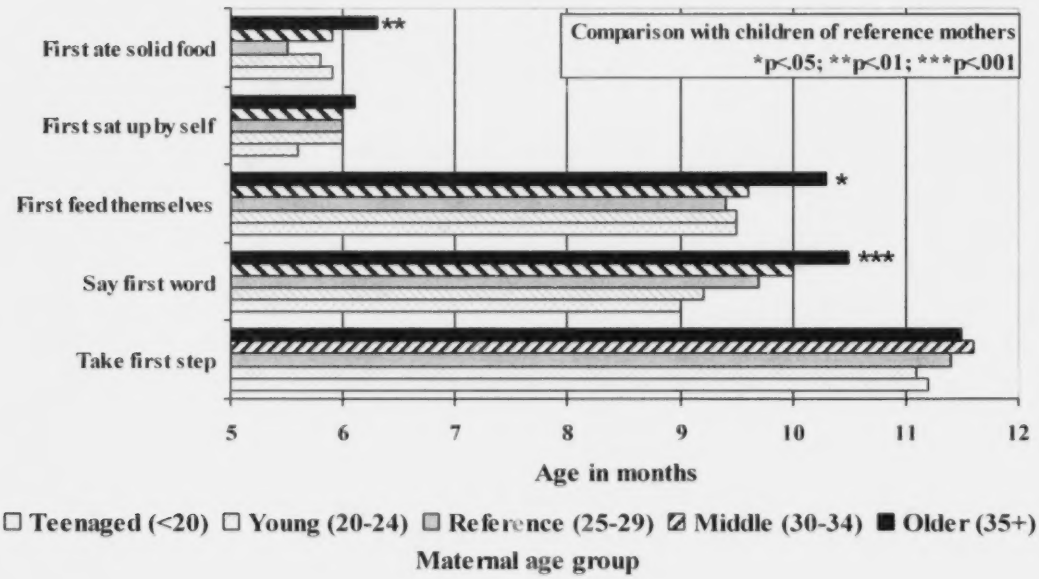
... not applicable
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Developmental milestones

Mothers were asked to report the age in months at which their child first achieved several developmental milestones. On average, mothers reported that their children were 5.8 months old when they started eating solid food, 6.0 months old when they first sat up by themselves, 9.6 months old when they first fed themselves, 9.7 months old when they said their first word, and 11.4 months old when they took their first step.

Examining differences across maternal age groups, age at achieving these milestones tended to increase with mother's age at birth (data table not shown). Children of older mothers were significantly older than children of reference mothers when they first started eating solid food (6.3 vs. 5.5 months old), when they first fed themselves (10.3 vs. 9.4 months old) and when they said their first word (10.5 vs. 9.7 months old; Figure 3). These differences represent nearly a month-long lag in achieving these milestones.

Figure 3 Mean age in months at which children achieved certain developmental milestones, by maternal age group



Source: Statistics Canada, National Longitudinal Survey of Children and Youth, cycles 3 through 6.

Many textbooks or reference documents present the average age by which the majority of children will have achieved various developmental milestones (Bayley, 1969; Shaffer, Wood, & Willoughby, 2005), while others present the typical age range for the acquisition of these skills (WHO Multicentre Growth Reference Study Group, 2006). Based on responses for the present sample, cut-points were derived to identify children who were late achievers of certain developmental milestones (see Appendix C for cut-point definitions).

Table 7 Late achievement of developmental milestones, by maternal age group

	Overall	Maternal Age Group				
		Teen-aged (younger than 20)	Young (20 to 24)	Reference (25 to 29)	Middle (30 to 34)	Older (35 or older)
Late to first sit up by self (8 months or older), %	13.6	9.4	12.6	10.5	17.1*	20.3*
Late to eat solid food (10 months or older), %	10.1	8.9	11.6	9.1	8.7	13.7
Late to feed themselves (13 months or older), %	11.3	11.1	10.2	9.1	12.8	17.4*
Late to say first word (13 months or older), %	10.0	7.8	7.4	9.9	11.9	13.9
Late to take first step (14 months or older), %	14.0	11.3	14.2	12.1	15.2	18.9

*p<.05; **p<.01; ***p<.001
Note:
Comparisons by maternal age are made against children of reference mothers.

Examining these developmental milestones further, two milestones – eating solid food and feeding oneself – are highly dependent on the behaviour of the mother (parent) and may not be fully reflective of the physical development of the child. Therefore, further examination of the late development of milestones was limited to the remaining three measures: (i) late to sit up by self, (ii) late to say first word, and (iii) late to take first step.

Late to sit up by self

Maternal age. A significantly greater proportion of children of middle (17%) and older mothers (20%) were late achievers of sitting up compared to children of reference mothers (11%; Table 7). In multivariate models, children of middle and older mothers had significantly greater odds of being late (8 months or older) to first sit up by themselves (Table 8).

Other factors. Gestational age and birth weight were associated with a child being late to sit up by themselves. Children born prematurely but at a normal birth weight had significantly higher odds of being late to sit up by themselves compared to full-term children (Table 8).

Late to say first word

Maternal age. On average, 14% of children of older mothers were late to say their first word. This was not significantly different from children of reference mothers (Table 7). In the multivariate model, maternal age was not significantly associated with the likelihood of children's being late (13 months or older) to say their first word (Table 8).

Other factors. In the model, only children born prematurely but not of low birth weight were found to have significantly increased odds of being late to say their first word (Table 8).

Late to take first steps

Maternal age. On average, 19% of children of older mothers were late to take their first steps. This was not significantly different from children of reference mothers (Table 7). In the multivariate model, maternal age was not significantly associated with the likelihood of children being late (14 months or older) to take their first steps.

Other factors. Children whose mothers had no more than a high school education were significantly more likely to be late in taking their first steps relative to children whose mothers had higher education. Children born prematurely, whether they were of low birth weight or not, were also at increased odds of being late in achieving this milestone (Table 8).

Table 8 Late to achieve developmental milestones: Odds ratios (ORs) and 95% confidence intervals (95% CIs) from multivariate logistic models

Characteristics	Late to sit up by self (8 months or older)		Late to say first word (13 months or older)		Late to take first step (14 months or older)	
	OR	95% CI	OR	95% CI	OR	95% CI
Maternal age group						
Teenaged (younger than 20)	1.08	(0.37, 3.13)	0.75	(0.28, 2.00)	0.64	(0.20, 2.07)
Young (ages 20 to 24)	1.38	(0.79, 2.43)	0.77	(0.41, 1.46)	0.99	(0.58, 1.68)
Reference (ages 25 to 29; Ref.)	1.00	...	1.00	...	1.00	...
Middle (ages 30 to 34)	1.97**	(1.19, 3.26)	1.44	(0.78, 2.65)	1.26	(0.78, 2.03)
Older (ages 35 or older)	2.73**	(1.47, 5.07)	1.73	(0.91, 3.31)	1.58	(0.88, 2.83)
Socio-demographic characteristics						
Child is male (Ref. Female)	0.79	(0.54, 1.15)	1.25	(0.83, 1.88)	1.14	(0.80, 1.63)
Low-income (Ref. Not low-income)	1.14	(0.59, 2.17)	1.15	(0.56, 2.36)	0.95	(0.50, 1.79)
High school graduate or less (Ref. More than high school education)	0.90	(0.55, 1.50)	1.05	(0.59, 1.87)	1.92**	(1.21, 3.03)
Single-parent household (Ref. Dual-parent household)	0.72	(0.32, 1.58)	1.17	(0.40, 3.39)	1.07	(0.45, 2.55)
Other characteristics						
Duration of breastfeeding						
None (Ref.)	1.00	...	1.00	...	1.00	...
6 months or less	1.03	(0.64, 1.66)	1.14	(0.56, 2.33)	0.73	(0.44, 1.22)
More than 6 months	0.59	(0.35, 1.00)	0.98	(0.47, 2.07)	0.66	(0.38, 1.16)
Birth term and weight						
Not preterm (Ref.)	1.00	...	1.00	...	1.00	...
Preterm, not low birth weight	2.17*	(1.15, 4.12)	2.07*	(1.03, 4.13)	2.02*	(1.04, 3.94)
Preterm, low birth weight	2.08	(0.96, 4.51)	2.09	(0.65, 6.67)	3.74***	(1.87, 7.48)

... not applicable
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Motor and social development (MSD)

Mothers responded to a series of age-specific questions regarding the motor and social skills possessed by their child, including gross and fine motor skills, perception and cognition, communication and language, and social development. These questions comprise the Motor and Social Development (MSD) scale. Although some of the child behaviours assessed by the MSD are dependent on the behaviour of the parent, this scale has been used in other studies of child development (Hediger, Overpeck, Ruan, & Troendle, 2002; Pevalin, Wade, & Brannigan, 2003). Overall, children had a mean standardized MSD score of 100.2 at ages 0 to 1, and 101.1 at ages 2 to 3 (Table 9).

Maternal age. Comparing scores by maternal age group (Table 9), children of middle and older mothers had significantly lower MSD scores at ages 0 to 1 compared to children of reference mothers. Conversely, children of teenaged and young mothers had significantly higher scores at ages 0 to 1 than reference mothers. These findings are consistent with other studies examining the motor and social development of children (Hediger et al., 2002; Pevalin et al., 2003).

Table 9 Motor and social development scores, by maternal age group, mean and standard error (SE)

	Overall		Maternal Age Group									
			Teenaged (younger than 20)		Young (20 to 24)		Reference (25 to 29)		Middle (30 to 34)		Older (35 or older)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Ages 0 to 1 (n=3,297)	100.2	0.4	103.3**	1.0	102.8**	0.7	100.0	0.6	98.1*	0.8	97.4*	1.2
Ages 2 to 3 (n=2,244)	101.1	0.4	101.3	1.0	100.9	0.8	101.2	0.6	102.1	0.8	98.9	1.1

*p<.05; **p<.01; ***p<.001

Note:

Comparisons by maternal age are made against children of reference mothers.

After controlling for the effects of other factors, being a child of a middle or older mother was no longer associated with MSD scores at ages 0 to 1 (Table 10). At ages 2 to 3, controlling for other factors revealed an association with older maternal age that had been suppressed in univariate analyses, indicating that children of older mothers had significantly lower MSD scores at ages 2 to 3 compared to children of reference mothers.

Other factors. Other characteristics were also significantly associated with MSD scores in these models (Table 10). Boys had significantly lower MSD scores than girls at ages 0 to 1 and 2 to 3. Children from low-income families had significantly lower MSD scores at ages 2 to 3. Children who were breastfed for more than 6 months had significantly higher MSD scores at both time points compared to children who were never breastfed. Lastly, children who were born both preterm and at low birth weight had significantly lower MSD scores at both ages 0 to 1 and ages 2 to 3.

Table 10 Motor and social development score by child's age: Beta coefficients and standard errors (SE) from multivariate linear models

Characteristics	Ages 0 to 1		Ages 2 to 3	
	Beta	SE	Beta	SE
Maternal age group				
Teenaged (younger than 20)	4.50**	1.50	1.35	1.64
Young (ages 20 to 24)	3.04**	0.95	0.50	1.04
Reference (ages 25 to 29; Ref.)	0.00	...	0.00	...
Middle (ages 30 to 34)	-1.67	0.94	0.74	0.96
Older (ages 35 or older)	-2.35	1.30	-2.61*	1.29
Socio-demographic characteristics				
Child is male (Ref. Female)	-2.02**	0.72	-4.30***	0.75
Low-income (Ref. Not low-income)	-0.05	1.22	-3.36*	1.43
High school graduate or less (Ref. More than high school education)	1.30	0.90	0.30	1.00
Single-parent household (Ref. Dual-parent household)	-0.58	1.30	-0.92	1.64
Other characteristics				
Duration of breastfeeding				
None (Ref.)	0.00	...	0.00	...
6 months or less	1.97	1.11	1.43	1.16
More than 6 months	3.77***	1.17	2.61*	1.21
Birth term and weight				
Not preterm (Ref.)	0.00	...	0.00	...
Preterm, not low birth weight	-2.05	1.34	-1.05	1.39
Preterm, low birth weight	-11.90***	1.94	-4.08*	1.86
R^2 for model	0.0813		0.0625	

... not applicable
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

8. Children's behaviour and cognitive development

Behavioural outcomes

The relative importance of early childhood behaviour in predicting later outcomes has been the subject of numerous studies (Broidy et al., 2003; Koko & Pulkkinen, 2000; Nagin & Tremblay, 1999; Stevens & Pihl, 1987). Given these long-term implications, it was of interest to examine the relationship between advanced maternal age at birth and a child's behaviour during early childhood.

Along with maternal age, other factors that have been linked to child behaviour were examined including: mother's education (Lipman, Offord, Dooley, & Boyle, 2002), household income (Lipman et al., 2002), single-parent status (Lipman et al., 2002), parenting practices (Chao & Willms, 2002; Thomas, 2004; Pettit, Bates, & Dodge, 2007), family functioning (Racine & Boyle, 2002), maternal depression (Somers & Willms, 2002) and low birth weight (Japel, Normand, Tremblay, & Willms, 2002). Each of these factors was considered with respect to four types of behaviour: physical aggression, emotional disorder and anxiety, hyperactivity and inattention, and positive behaviour.

Table 11 Behaviour scores by child's age, by maternal age group

	Overall		Maternal Age Group									
			Teenaged (younger than 20)		Young (20 to 24)		Reference (25 to 29)		Middle (30 to 34)		Older (35 or older)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Physical aggression												
Ages 2 to 3, (n=2,316)[a]	4.3	0.1	4.8*	0.3	4.6	0.2	4.2	0.1	4.3	0.2	4.0	0.2
Ages 4 to 5, (n=1,687)[b]	1.5	0.1	1.5	0.2	1.5	0.1	1.4	0.1	1.5	0.1	1.4	0.2
Emotional disorder/anxiety												
Ages 2 to 3, (n=2,321)[b]	1.4	0.1	1.3	0.1	1.4	0.1	1.5	0.1	1.4	0.1	1.6	0.2
Ages 4 to 5, (n=1,684)[c]	2.3	0.1	2.3	0.3	2.0	0.1	2.2	0.1	2.6*	0.2	2.3	0.3
Hyperactivity												
Ages 2 to 3, (n=2,314)[b]	3.6	0.1	4.1*	0.2	3.8	0.1	3.5	0.1	3.5	0.1	3.6	0.2
Ages 4 to 5, (n=1,676)[c]	4.3	0.1	4.5	0.3	4.4	0.2	4.0	0.1	4.4	0.2	4.5	0.4
Positive behaviour												
Ages 4 to 5, (n=1,676)[b]	8.5	0.1	8.2	0.2	8.4	0.1	8.6	0.1	8.6	0.2	8.1	0.3

[a] possible scores range from 0 through 16
[b] possible scores range from 0 through 12
[c] possible scores range from 0 through 14
*p<.05; **p<.01; ***p<.001
Note:
Comparisons by maternal age are made against children of reference mothers.

Physical aggression

Children had an average score of 4.3 out of 16 on the measure of physical aggression at ages 2 to 3, and an average score of 1.5 out of 12 at ages 4 to 5 (Table 11).

Maternal age. Children of older mothers did not differ in their average aggression scores from children of reference mothers at either time point. Children of teenaged mothers, however, scored significantly higher in physical aggression at ages 2 to 3 compared to children of reference mothers (Table 11). However, once all other factors were controlled for, maternal age at birth was not associated with this outcome at either time point (Table 12).

Table 12 Physical aggression score by child's age: Beta coefficients and standard errors (SE) from multivariate linear models

Characteristics	Ages 2 to 3		Ages 4 to 5	
	Beta	SE	Beta	SE
Maternal age group				
Teenaged (younger than 20)	0.08	0.35	-0.06	0.27
Young (ages 20 to 24)	0.18	0.20	0.17	0.16
Reference (ages 25 to 29; Ref.)	0.00	...	0.00	...
Middle (ages 30 to 34)	0.10	0.18	0.12	0.15
Older (ages 35 or older)	-0.37	0.23	0.03	0.24
Socio-demographic characteristics				
Child is male (Ref. Female)	0.01	0.14	0.24*	0.12
Low-income (Ref. Not low-income)	0.22	0.29	0.18	0.21
High school graduate or less (Ref. More than high school education)	0.13	0.21	0.34*	0.16
Single-parent household (Ref. Dual-parent household)	-0.24	0.35	-0.21	0.28
Other characteristics				
Positive parent-child interaction (0 to 20)[a]	-0.04	0.04	0.03	0.03
Ineffective parent-child interaction (0 to 28)[ab]	0.34***	0.02	0.24***	0.02
Family functioning (0 to 36)[ac]	0.02	0.01	0.00	0.01
Birth term and weight				
Not preterm (Ref.)	0.00	...	0.00	...
Preterm, not low birth weight	0.25	0.29	-0.09	0.23
Preterm, low birth weight	0.24	0.43	-0.47*	0.22
Mother's depressive symptoms (0 to 36)[a]	0.08***	0.02	0.02	0.02
R^2 for model	0.2733		0.2168	

... not applicable

[a] measured at same age as outcome

[b] a higher score means more hostile or ineffective parenting

[c] a higher score means greater family dysfunction

*p<.05; **p<.01; ***p<.001

Note:

Characteristics measured when child was aged 0 to 1 unless otherwise noted.

All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Other factors. Children whose mothers reported more ineffective parenting practices scored higher in physical aggression at both time points, which is consistent with other research (Chao & Willms, 2002; Thomas, 2004). Children whose mother reported more depressive symptoms scored higher in physical aggression at ages 2 to 3 but not later at ages 4 to 5. At ages 4 and 5, boys had higher scores than girls, and children whose mother had a high school diploma or less also had higher scores than those whose mother had more education. Children born preterm and at low birth weight, however, had significantly lower average scores in physical aggression (Table 12).

Emotional disorder and anxiety

Average scores on the emotional disorder/anxiety scale were 1.4 (out of 12) at ages 2 to 3, and 2.3 (out of 14) at ages 4 to 5 (Table 11).

Maternal age. At ages 2 to 3, there was no significant variation in average score by maternal age group (Table 11). At ages 4 to 5, while children of older mothers saw no difference in their average scores compared to the reference group, children born to middle mothers had significantly higher emotional disorder and anxiety scores compared to children of reference mothers (Table 11).

Once other factors were taken into account (Table 13), children of older mothers had similar emotional disorder and anxiety scores as children of reference mothers. However, children of teenaged and young mothers scored significantly lower in emotional disorder and anxiety at ages 2 to 3, but not at ages 4 to 5, compared to the reference group (Table 13).

Other factors. Higher emotional disorder scores were associated with more ineffective parenting practices and greater symptoms of maternal depression at both time points (Table 13). At ages 2 to 3 only, lower emotional disorder scores were observed for children with higher positive parenting scores as well as for children born both preterm and at low birth weight.

Table 13 Emotional disorder and anxiety score by child's age: Beta coefficients and standard errors (SE) from multivariate linear models

Characteristics	Ages 2 to 3		Ages 4 to 5	
	Beta	SE	Beta	SE
Maternal age group				
Teenaged (younger than 20)	-0.37*	0.18	-0.17	0.28
Young (ages 20 to 24)	-0.25*	0.12	-0.21	0.16
Reference (ages 25 to 29; Ref.)	0.00	...	0.00	...
Middle (ages 30 to 34)	0.00	0.13	0.46*	0.19
Older (ages 35 or older)	-0.03	0.16	-0.05	0.24
Socio-demographic characteristics				
Child is male (Ref. Female)	-0.15	0.09	-0.01	0.14
Low-income (Ref. Not low-income)	-0.06	0.19	-0.10	0.22
High school education or less (Ref. More than high school education)	0.05	0.13	0.24	0.19
Single-parent household (Ref. Dual-parent household)	0.06	0.24	-0.04	0.30
Other characteristics				
Positive parent-child interaction (0 to 20)[a]	-0.05*	0.02	-0.04	0.03
Ineffective parent-child interaction (0 to 28)[ab]	0.07***	0.01	0.14***	0.02
Family functioning (0 to 36)[ac]	0.01	0.01	0.01	0.01
Birth term and weight				
Not preterm (Ref.)	0.00	...	0.00	...
Preterm, not low birth weight	0.40	0.26	0.47	0.28
Preterm, low birth weight	-0.49**	0.16	-0.27	0.02
Mother's depressive symptoms (0 to 36)[a]	0.05***	0.01	0.06**	0.02
R^2 for model	0.0987		0.1354	

... not applicable
[a] measured at same age as outcome
[b] a higher score means more hostile or ineffective parenting
[c] a higher score means greater family dysfunction
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1 unless otherwise noted.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Hyperactivity and inattention

Average scores on the hyperactivity/inattention scale were 3.6 (out of 12) at ages 2 to 3, and 4.3 (out of 14) at ages 4 to 5 (Table 11).

Maternal age. Children of older mothers had similar hyperactivity and inattention scores as children of reference mothers, while children of teenaged mothers scored significantly higher in hyperactivity and inattention at ages 2 and 3 (Table 11). The relationship with maternal age disappeared, however, once other factors were taken into account (Table 14).

Other factors. In the multivariate models, parenting practices and maternal depression were significantly associated with hyperactivity and inattention at both time points (Table 14). Increases in ineffective parenting practices and mother's depressive symptoms scores were linked to increases in hyperactivity scores. Higher positive parenting practice scores, on the other hand, were associated with a decline in hyperactivity.

At ages 2 to 3, low-income children had higher average scores in hyperactivity compared to children with greater household income. At ages 4 to 5, boys scored significantly higher in hyperactivity compared to girls; this gender difference was not observed at ages 2 to 3 (Table 14).

Table 14 Hyperactivity and inattention score by child's age: Beta coefficients and standard errors (SE) from multivariate linear models

Characteristics	Ages 2 to 3		Ages 4 to 5	
	Beta	SE	Beta	SE
Maternal age group				
Teenaged (younger than 20)	0.06	0.27	0.33	0.40
Young (ages 20 to 24)	0.08	0.15	0.27	0.22
Reference (ages 25 to 29; Ref.)	0.00	...	0.00	...
Middle (ages 30 to 34)	-0.09	0.17	0.42	0.23
Older (ages 35 or older)	-0.06	0.24	0.34	0.33
Socio-demographic characteristics				
Child is male (Ref. Female)	-0.02	0.12	0.60***	0.17
Low-income (Ref. Not low-income)	0.46*	0.21	0.29	0.25
High school graduate or less (Ref. More than high school education)	-0.18	0.15	0.27	0.23
Single-parent household (Ref. Dual-parent household)	0.02	0.24	0.34	0.32
Other characteristics				
Positive parent-child interaction (0 to 20)[a]	-0.10**	0.03	-0.11**	0.04
Ineffective parent-child interaction (0 to 28)[ab]	0.22***	0.02	0.27***	0.03
Family functioning (0 to 36)[ac]	-0.01	0.01	-0.04*	0.02
Birth term and weight				
Not preterm (Ref.)	0.00	...	0.00	...
Preterm, not low birth weight	0.10	0.24	0.14	0.28
Preterm, low birth weight	0.42	0.28	0.03	0.42
Mother's depressive symptoms (0 to 36)[a]	0.05***	0.01	0.08***	0.02
R^2 for model	0.1706		0.2114	

... not applicable
[a] measured at same age as outcome
[b] a higher score means more hostile or ineffective parenting
[c] a higher score means greater family dysfunction
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1 unless otherwise noted.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Positive behaviour

Overall, children had an average score of 8.5 out of 12 on the positive behaviour scale, which assessed a child's perseverance and independence (Table 11).

Maternal age. Children of older mothers did not differ in their average scores from children of reference mothers (Table 11). In the multivariate model, the differences between children of older and reference mothers became statistically significant, with children of older mothers scoring significantly lower in positive behaviour compared to the reference group (Table 15).

Table 15 Positive behaviour score at ages 4 and 5: Beta coefficients and standard errors (SE) from multivariate linear model

Characteristics	Beta	SE
Maternal age group		
Teenaged (younger than 20)	-0.25	0.29
Young (ages 20 to 24)	-0.22	0.17
Reference (ages 25 to 29; Ref.)	0.00	...
Middle (ages 30 to 34)	0.01	0.17
Older (ages 35 or older)	-0.52*	0.24
Socio-demographic characteristics		
Child is male (Ref. Female)	-0.61***	0.13
Low-income (Ref. Not low-income)	0.50*	0.24
High school graduate or less (Ref. More than high school education)	-0.52**	0.18
Single-parent household (Ref. Dual-parent household)	-0.93**	0.31
Other characteristics		
Positive parent-child interaction (0 to 20)[a]	0.10***	0.03
Ineffective parent-child interaction (0 to 28)[ab]	-0.21***	0.02
Family functioning (0 to 36)[ac]	-0.04**	0.01
Birth term and weight		
Not preterm (Ref.)	0.00	...
Preterm, not low birth weight	0.02	0.29
Preterm, low birth weight	-0.11	0.26
Mother's depressive symptoms (0 to 36)[a]	0.01	0.02
R^2 for model	0.2376	

... not applicable
[a] measured at same age as outcome
[b] a higher score means more hostile or ineffective parenting
[c] a higher score means greater family dysfunction
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1 unless otherwise noted.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Other factors. Boys had significantly lower positive behaviour scores than girls, as did children in single-parent households, and children whose mother had a high school diploma or less (Table 15). Ineffective parenting practices and higher family dysfunction were also linked to lower scores. Positive parenting practices, on the other hand, were significantly related to increases in children's positive behaviour scores.

Cognitive outcomes

Early cognitive abilities can have implications for social and academic success later in life (Feinstein & Duckworth, 2006; Stevenson & Newman, 1986). Three measures of cognitive ability at ages 4 to 5 were examined in this study: receptive vocabulary skills, number knowledge, and copying and symbol use.

Maternal age at birth, socio-demographic characteristics, parenting practices, family functioning, gestational age and birth weight, and whether the child was read to daily were each examined in relation to the child's cognitive abilities.

Table 16 Children's cognitive skills at ages 4 and 5, by maternal age group, mean and standard error (SE)

	Overall		Maternal Age Group									
			Teenaged (younger than 20)		Young (20 to 24)		Reference (25 to 29)		Middle (30 to 34)		Older (35 or older)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Receptive vocabulary (n=1,554)	103.3	0.6	100.8**	1.4	98.5***	1.0	105.4	0.8	104.8	1.2	106.2	2.4
Number knowledge (n=1,558)	98.6	0.6	91.5***	1.6	96.0***	1.2	100.8	0.9	100.3	1.2	98.4	1.8
Copying & symbol use (n=1,406)	100.5	0.7	92.8***	2.1	97.8***	1.4	104.3	1.0	100.1*	1.5	99.9	2.2

*p<.05; **p<.01; ***p<.001
Note:
Comparisons by maternal age are made against children of reference mothers.

Receptive vocabulary

Children, on average, scored 103.3 in receptive vocabulary at ages 4 and 5 (Table 16).[1]

Maternal age. Children of older mothers did not differ significantly from the reference group, while children of teenaged and young mothers had significantly lower average receptive vocabulary scores (Table 16). Once other factors were taken into account, only children of young mothers persisted in having significantly lower scores in receptive vocabulary (Table 17).

1. Although it is beyond the scope of this paper to compare the outcomes of first-born children to higher birth order children, it is worth noting that first-born children scored significantly higher (p<.001) in receptive vocabulary at ages 4 to 5 compared to the non first-born children whose average score was 100.9.

Other factors. Lower scores were observed among children whose mother had a high school diploma or less, children with a single-parent mother, or children who were not read to daily. Higher scores in receptive vocabulary were observed among children whose mother reported more positive parenting practices (Table 17).

Table 17 Receptive vocabulary score at ages 4 and 5: Beta coefficients and standard errors (SE) from multivariate linear model

Characteristics	Beta	SE
Maternal age group		
Teenaged (younger than 20)	1.41	2.06
Young (ages 20 to 24)	-4.14***	1.22
Reference (ages 25 to 29; Ref.)	0.00	...
Middle (ages 30 to 34)	-0.02	1.33
Older (ages 35 or older)	1.60	2.20
Socio-demographic characteristics		
Child is male (Ref. Female)	-1.27	0.96
Low-income (Ref. Not low-income)	-0.86	1.80
High school graduate or less (Ref. More than high school education)	-6.77***	1.37
Single-parent household (Ref. Dual-parent household)	-5.02*	2.13
Other characteristics		
Positive parent-child interaction (0 to 20)[a]	0.48*	0.22
Ineffective parent-child interaction (0 to 28)[ab]	0.10	0.16
Family functioning (0 to 36)[ac]	-0.14	0.09
Birth term and weight		
Not preterm (Ref.)	0.00	...
Preterm, not low birth weight	-0.25	1.91
Preterm, low birth weight	-4.49	2.60
Child not read to daily[a]	-4.28***	1.13
R^2 for model	0.1437	

... not applicable
[a] measured at same age as outcome
[b] a higher score means more hostile or ineffective parenting
[c] a higher score means greater family dysfunction
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1 unless otherwise noted.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Number knowledge

The children's average score in number knowledge was 98.6 at ages 4 and 5 (Table 16).

Maternal age. Children of older mothers did not differ significantly from children born to reference mothers (Table 16). Children of teenaged and young mothers, on the other hand, performed significantly worse in number knowledge at ages 4 and 5 and this relationship persisted once other factors were taken into account (Table 18).

Other factors. As with receptive vocabulary, mother's education and daily reading were significantly linked to number knowledge. In addition, children born preterm and with low birth weight had significantly lower number knowledge scores compared to full term children (Table 18).

Table 18 Number knowledge score at ages 4 and 5: Beta coefficients and standard errors (SE) from multivariate linear model

Characteristics	Beta	SE
Maternal age group		
Teenaged (younger than 20)	-5.07*	2.35
Young (ages 20 to 24)	-4.01**	1.52
Reference (ages 25 to 29; Ref.)	0.00	...
Middle (ages 30 to 34)	-0.34	1.41
Older (ages 35 or older)	-2.04	2.10
Socio-demographic characteristics		
Child is male (Ref. Female)	-1.79	1.07
Low-income (Ref. Not low-income)	-1.51	1.78
High school graduate or less (Ref. More than high school education)	-3.05*	1.47
Single-parent household (Ref. Dual-parent household)	-0.81	2.05
Other characteristics		
Positive parent-child interaction (0 to 20)[a]	0.21	0.22
Ineffective parent-child interaction (0 to 28)[ab]	-0.15	0.15
Family functioning (0 to 36)[ac]	-0.09	0.11
Birth term and weight		
Not preterm (Ref.)	0.00	...
Preterm, not low birth weight	-1.91	2.66
Preterm, low birth weight	-7.68**	2.50
Child not read to daily[a]	-3.48**	1.26
R^2 for model	0.0773	

... not applicable
[a] measured at same age as outcome
[b] a higher score means more hostile or ineffective parenting
[c] a higher score means greater family dysfunction
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1 unless otherwise noted.
All estimates have been adjusted for the cycle (year) of entry into the NLSCY.

Copying and symbol use

Children's average copying and symbol use score at ages 4 and 5 was 100.5 (Table 16).

Maternal age. Children of older mothers did not differ significantly in copying and symbol use from children born to reference mothers (Table 16). Children of teenaged, young and middle mothers, however, all performed significantly worse than the reference group.

Once other factors were taken into account (Table 19), the significance of the relationship between maternal age at birth and copying and symbol use persisted for children of teenaged and young mothers. However, scores for children of middle mothers were no longer significantly different from those of children of reference mothers.

Other factors. Significantly lower copying and symbol use scores were observed among boys, children with less educated mothers, children born preterm (regardless of whether they were of low birth weight or not), and children who were not read to daily (Table 19).

Table 19 Copying and symbol use score at ages 4 and 5: Beta coefficients and standard errors (SE) from multivariate linear model

Characteristics	Beta	SE
Maternal age group		
Teenaged (younger than 20)	-5.98*	2.68
Young (ages 20 to 24)	-5.48**	1.71
Reference (ages 25 to 29; Ref.)	0.00	...
Middle (ages 30 to 34)	-2.28	1.66
Older (ages 35 or older)	-3.39	2.55
Socio-demographic characteristics		
Child is male (Ref. Female)	-8.64***	1.22
Low-income (Ref. Not low-income)	-3.20	2.34
High school graduate or less (Ref. More than high school education)	-3.28	1.73
Single-parent household (Ref. Dual-parent household)	-0.74	2.52
Other characteristics		
Positive parent-child interaction (0 to 20)[a]	0.21	0.25
Ineffective parent-child interaction (0 to 28)[ab]	-0.32	0.19
Family functioning (0 to 36)[ac]	0.09	0.13
Birth term and weight		
Not preterm (Ref.)	0.00	...
Preterm, not low birth weight	-3.97*	1.89
Preterm, low birth weight	-9.17**	3.03
Child not read to daily[a]	-3.42*	1.37
R^2 for model	0.1563	

... not applicable
[a] measured at same age as outcome
[b] a higher score means more hostile or ineffective parenting
[c] a higher score means greater family dysfunction
*p<.05; **p<.01; ***p<.001
Note:
Characteristics measured when child was aged 0 to 1 unless otherwise noted.

9. Discussion

In Canada, it is increasingly common for women to delay childbearing. The proportion of Canadian women in their thirties and forties having a first child has increased in the past 20 years.

NLSCY data indicated that children of older mothers shared a similar socio-demographic profile with children of reference mothers. There were no significant differences between the proportions of children of older and reference mothers who had a mother with a high school diploma or less, lived in a low-income household or lived with a mother who was a single parent.

The children of older mothers were, however, more likely than children of reference mothers to be exposed to prenatal and perinatal risk factors. Higher proportions of children of older mothers had a mother who had suffered from hypertension during pregnancy, were born preterm, and had a caesarean delivery.

In summary, children of older mothers were born into similar socio-economic circumstances, but tended to experience more prenatal and perinatal risks compared to children of reference mothers. To effectively assess the link between late childbearing and children's outcomes, it was important to consider this information in the analysis. Consequently, the present study examined the relationship between late childbearing and children's developmental outcomes while taking these additional factors into account. In doing so, it was possible to isolate the relationship between maternal age at birth and the outcome, while also shedding some light on the relative importance of these additional factors.

Maternal age and children's outcomes

The results of this study showed that children of older mothers were no different from children of reference mothers with respect to many developmental outcomes. For some outcomes, this similarity was immediately apparent from a descriptive perspective. For others, initial differences disappeared once additional factors were taken into account.

For example, children of older mothers were as likely as children of reference mothers to have received special care at birth, to be in excellent or very good health during early childhood, or to be diagnosed with asthma. They shared similar timing with respect to saying their first word and taking their first step and had similar averages scores in physical aggression, emotional disorder and anxiety, and hyperactivity and inattention. Children of older mothers also had similar scores in receptive vocabulary, number knowledge, and copying and symbol use as children of reference mothers.

However, advanced maternal age was significantly associated with other outcomes. Even after controlling for a number of characteristics, a higher proportion of children of older mothers were considered as late achievers in sitting up by themselves compared to children of reference mothers. In addition, children of older mothers scored lower on the motor and social

development scale at ages 0 to 1 and 2 to 3. They also had lower positive behaviour scores at ages 4 and 5.

The relative importance of perinatal health and socio-demographic characteristics

Several factors other than maternal age showed significant associations with the developmental outcomes examined in this study. These included mother's education, single-parent status, household income and the child's gestational age and birth weight.

For example, mother's education was particularly important in terms of children's cognitive development. Children of mothers with a high school diploma or less had significantly lower receptive vocabulary, number knowledge and copying and symbol use scores compared to children whose mothers had a higher level of education.

Furthermore, regardless of maternal age at birth, children who were born preterm fared less well than children born at full term. This was particularly true for outcomes that were tied to a child's chronological age. For example, children born preterm were significantly more likely to be late in achieving developmental milestones and scored lower on the MSD scale compared to children who were not born preterm. Given that the attainment of milestones and the development of motor and social skills are possibly affected by differences between a child's chronological and biological age, observing a delay among preterm children (who are biologically younger than their full-term counterparts) may not be surprising. However, the clinical significance of these lags is not clear from the present study, nor is it clear whether they will be important as the child ages.

Study limitations

As with any study, this study had some limitations. The first was the size of the sample. Although there were more than 3,000 children in this study's baseline sample, due to sample and survey design (see Appendix A), the sample diminished at older ages (e.g. ages 2 through 5). Consequently, certain differences that may have appeared meaningful did not reach statistical significance. As the NLSCY continues to recruit and follow younger cohorts of children, these analyses may be re-run with a larger sample of children.

Sample size limitations precluded examining the outcomes of children whose mothers were aged 40 and over at the child's birth. Studies of fertility and fecundity suggest that, compared to younger women, women aged 40 and older experience significant declines in their ability to conceive and to bring a child to term (Fretts et al., 1995; Gougeon, 2005; Ziadeh & Yahaya, 2001), while little information exists regarding the outcomes for their children. By grouping children born to women in their forties together with children born to women in their late thirties, the current study may have masked differences in their respective children's outcomes.

The second limitation was the age period of analysis. Due to the survey design, this study could only examine children's development up to age 5. It is possible that distinctions between children of older and reference mothers may not emerge until later in childhood. For example,

the majority of children in this study were not yet in school. Other research has shown that intellectual differences in children born to younger versus older mothers become more pronounced as the child ages and develops (Brooks-Gunn & Furstenberg, 1986). Thus, differences in various academic and school-related outcomes may emerge after age 5.

A further limitation is that many of the measures used in the NLSCY are based on maternal reports, which may result in error or bias. While certain biases are known to exist, such as the tendency for parents to underreport their child's height (Shields, 2006), the potential bias in other measures is unknown. Furthermore, the biases may differ between maternal age groups. These biases may act to either conceal a real difference or, conversely, may establish a false association. However, for many measures, such as developmental milestones, the best and perhaps only option is maternal report.

Despite these limitations, the present study offers novel insight into the relationship between late childbearing and children's development in the Canadian context.

Conclusions and future research

This study found that, in general, older maternal age was not significantly associated with children's physical, behavioural or cognitive outcomes measured between the ages of 0 and 5. However, this study demonstrated that higher socio-economic status was positively associated with positive outcomes, while birth-related risk factors were linked with poorer outcomes. Given that both sets of characteristics are relatively more common among children of older mothers, could they be interacting in some fashion to obscure a direct relationship between maternal age and child outcomes? Future research could explore the interrelationships between maternal age, socio-economic status and birth-related risks, and investigate indirect and direct links between each of these factors and children's outcomes.

This study also focussed on children's outcomes between the ages of 0 and 5. As more cycles of data become available, future research could examine the relationship between maternal age at birth and outcomes measured later on in childhood and during adolescence.

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Appendix A: The National Longitudinal Survey of Children and Youth

Survey objectives

The National Longitudinal Survey of Children and Youth (NLSCY) is a long-term study of Canadian children that follows their development from birth to early adulthood. The NLSCY began in 1994 and is conducted jointly by Statistics Canada and Human Resources and Social Development Canada. The survey is designed to collect information about factors influencing the social, emotional, behavioural, physical and cognitive development of children, and to monitor the impact of these factors on their development over time. The survey covers a broad range of topics including health, physical development, learning, behaviour, and social environment (family, friends, schools and communities).

Survey design

The NLSCY sample frame in the first cycle of the survey (1994-1995) was based on the Labour Force Survey (LFS), a monthly survey of households in Canada conducted by Statistics Canada. Households with children aged 0 to 11 in the ten provinces were selected from the LFS in 1994 to participate in the NLSCY. Of 26,000 eligible households, approximately 23,000 responded.

The first cycle of the NLSCY was conducted between November 1994 and June 1995. The longitudinal cohort from that cycle has been monitored every two years since. In addition, new panels of children aged 0 to 1 have been added to the survey at each data collection. These children are also followed every two years until the ages of 4 and 5, after which time they are dropped from the sample.

For children under 16 years of age, most of the information in the survey is provided by the person most knowledgeable about the child (known as the PMK in the NLSCY), usually the mother. She provides information about herself, the household and family, and the child. In addition, children aged 10 and over provide some information about themselves on a self-completed questionnaire. Direct measures of the child's abilities may also be taken, depending on the child's age. In some cycles of the NLSCY, school teachers and principals also completed a survey, again depending on the age and school status of the child, and on whether permission is given by the parent.

The present sample

Four cycles of NLSCY data were used in this analysis. The collection periods were as follows: Cycle 3 (October 1998 to June 1999), Cycle 4 (September 2000 to May 2001), Cycle 5 (September 2002 to June 2003), and Cycle 6 (September 2004 to June 2005).

Children were identified for inclusion in this study from each cycle at the age of 0 to 1 if they met the following criteria:

i. they responded in all applicable cycles,

ii. their biological mother was the PMK at each cycle, and
iii. they were first-born children.

Children were classified as first-born if their year of birth matched the year for which the mother reported having her first child.

Table A.1 presents the sample selection breakdown for the children in this study.

Table A.1 Sample loss and size by selection criteria

Sample selection procedure	Sample size
Total number of 0 to 1-year-olds interviewed in cycles 3 through 6	18,907
Children who were dropped from the longitudinal sample	- 152
Additional children lost to attrition	- 3,094
Additional children whose biological mother was not the PMK at all time periods	- 3,211
Additional children who were not first-born	- 8,456
Additional children for whom first-born status was unknown	- 612
Total number of children included in this study	**3,382**

Note. The application of selection criteria was sequential. As such, the numbers shown in the above table do not necessarily represent the number of children in the sample with a particular characteristic (e.g., children whose biological mother was not the PMK at all time points may also include some children who were not first-borns).

The 3,382 children retained for the present study represent about 556,000 children in the Canadian population.

This study was interested in outcomes measured during early childhood. Due to the NLSCY longitudinal sample design, early childhood was limited to ages 0 to 5 and data were collected at starting at ages 0 to 1, two years later at ages 2 to 3, and once again at ages 4 to 5.

For this study, children were pooled together from four cycles of the NLSCY. As a result, not all children had data at all time points. The availability of data depended upon the cycle in which the child was introduced to the NLSCY. As can be seen in Table A.2, while all of the children in this study have data for characteristics measured at ages 0 to 1, only those children who were introduced in Cycles 3 and 4 have data at ages 4 to 5.

Table A.2 Age of child at each cycle of interview

NLSCY cycle in which child was introduced	Child's age at cycle of interview			
	Cycle 3	Cycle 4	Cycle 5	Cycle 6
Cycle 3	0 to 1	2 to 3	4 to 5	..
Cycle 4	...	0 to 1	2 to 3	4 to 5
Cycle 5	...	...	0 to 1	2 to 3
Cycle 6	...	...	...	0 to 1

.. not available for specific reference period
... not applicable

As a result, there were 3,382 children with data at ages 0 to 1, 2,365 children with data two years later at ages 2 to 3, and 1,705 children with data two years after that at ages 4 to 5.

Weighting and variance estimation

To calculate all point estimates, the appropriate longitudinal survey weight was used (Table A.3), along with the corresponding bootstrap weights for variance estimation and significance tests. Children introduced in Cycle 6 were the exception; the cross-sectional survey and bootstrap weights were used for this cohort. All weights were taken from the *last* cycle to which the child responded.

Table A.3 Appropriate survey weight by cycle of entry to the NLSCY

Cohort	Survey weight variable
Cohort introduced in Cycle 3	Longitudinal weight from cycle 5 (EWTCW01L)
Cohort introduced in Cycle 4	Longitudinal weight from cycle 6 (FWTCW01L)
Cohort introduced in Cycle 5	Longitudinal weight from cycle 6 (FWTCW01L)
Cohort introduced in Cycle 6	Cross-sectional weight from cycle 6 (FWTCW01C)

Each of these survey weights allows one to make inferences about the population of Canadian children represented by the sample that entered the survey at ages 0 to 1.

Analysis of non-response

A number of children were dropped from this study because they did not meet the sample selection criteria (Table A.1). In effect, these children became non-respondents. Given that non-response has the potential to bias results if non-respondents have significantly different characteristics from respondents, it was important to assess the possible impact on the analysis.

As mentioned in the previous section, 3,094 eligible 0 to 1-year-olds were lost to attrition and a further 3,211 were excluded because their biological mother was not the PMK at all cycles. Of this first group, 625 were first-born children whose biological mother was the PMK during the first interview. Of the second group, 396 were first-born children whose biological mother was the PMK during the first interview. For the following analysis of non-response, these two subgroups were compared to the 3,382 children retained in the study. Comparisons were made with respect to a number of characteristics that were assessed at ages 0 to 1 and were discussed in the main analysis.

For comparison purposes, each child was assigned his/her cross-sectional weight from their first cycle of interview, and the corresponding bootstrap weights were applied for variance estimation and significance tests (Table A.4). Note that for respondents in the final study sample, this weighting strategy differs from that used in the main analysis.

Table A.4 Sample weight for attrition analysis by cycle of entry to NLSCY

Cohort	Survey weight variable
Cohort introduced in Cycle 3	Cross-sectional weight from cycle 3 (CWTCW01C)
Cohort introduced in Cycle 4	Cross-sectional weight from cycle 4 (DWTCW01C)
Cohort introduced in Cycle 5	Cross-sectional weight from cycle 5 (EWTCW01C)
Cohort introduced in Cycle 6	Cross-sectional weight from cycle 6 (FWTCW01C)

Socio-demographic characteristics. Children lost to attrition (Group 1) differed significantly from children in the study sample (Group 3) on several socio-demographic characteristics (Table A.5). A greater proportion of Group 1 children had a teenaged or young mother, had a mother with a high school diploma or less, lived in a low-income household, or had a mother who was a single parent.

There were almost no differences between children whose biological mother had not been the PMK over time (Group 2) and children in the final sample (Group 3). The exception was that a lower proportion of Group 2 children had a mother who was a single parent (Table A.5).

Prenatal and perinatal characteristics. Compared to children in the study sample, a lower proportion of Group 1 children had a mother who suffered from gestational diabetes, while a greater proportion had a mother who smoked throughout pregnancy (Table A.5). There were no differences between Group 2 children and those in the study sample.

Neither Group 1 nor Group 2 children differed from children in the study sample with respect to perinatal characteristics.

Health characteristics. The only significant difference between Group 1 and Group 3 children was the mother's higher average depressive symptoms score among the former group (Table A.5). In addition, a smaller proportion of Group 2 children reported that the child was in excellent or very good health compared to the children in the final study sample.

Table A.5 Children's characteristics at ages 0 to 1 by response status in attrition analysis

	First-born children whose biological mother was the PMK at Cycle 1		Group 3: Children in study sample[1] (n= 3,382)
	Group 1: Children lost to attrition (n=625)	Group 2: Children whose biological mother not PMK over time (n=396)	
Socio-demographic characteristics			
Maternal age group, %			
Teenaged (younger than 20)	13.8***	5.0	6.6
Young (ages 20 to 24)	28.0*	20.6	22.2
Reference (ages 25 to 29; Ref.)	31.4	36.9	35.6
Middle (ages 30 to 34)	17.1**	26.2	24.6
Older (ages 35 or older)	9.7	11.3	11.1
Child is male, %	47.3	57.4	51.7
Mother's education is high school or less, %	33.9***	25.9	20.7
Low-income household, %	25.4***	12.4	17.0
Mother is single parent, %	23.3***	5.6***	12.3
Prenatal and perinatal			
Gestational diabetes, %	3.2**	7.5	5.8
Gestational hypertension, %	10.8	13.8	13.9
Smoked throughout pregnancy, %	17.2**	9.6	10.9
Caesarean delivery, %	20.5	29.1	24.4
Preterm birth, %	11.5	9.1	12.3
Low birth weight, %	7.6	9.3	7.4
Health			
Child required special care at birth, %	19.2	18.5	20.3
Child diagnosed with asthma, %	5.4	2.1	3.4
Child's general health was excellent or very good, %	92.7	91.0*	93.1
Mother's depressive symptoms, mean	4.7*	4.0	3.9
Child's motor and social development score, mean	101.8	99.4	100.1

*p<.05; **p<.01; ***p<.001

Note:

1. Because the weighting strategy differs for the non-response analysis compared to the main analysis, these estimates will not match exactly those presented in the main body of the paper.
2. Comparisons by response category are made against Group 3 respondents.

The non-response analysis suggested that excluding children from the study sample because the PMK at each interview was not the biological mother did not result in any significant bias. Children excluded from the study for this reason did not differ significantly from the final sample on any of the examined characteristics except for single-parent status and the child's general health measure.

There were, however, several significant differences between the children lost to attrition and children in the study sample. For the most part, all of these differences reflect the fact that children who drop out of the NLSCY over time in general are more likely to have lower socio-economic status (SES) than those who remain. There are two main reasons why possible bias resulting from the loss of these children is not a serious concern to the main study. First, the longitudinal weights provided with the data have been adjusted to address this type of non-response. Second, the children born to older mothers were, on average, of relatively high SES and therefore less likely to drop out of the survey. Bias may have been more of a concern if the focus of this paper had been on children of teenaged mothers rather than those of older mothers. Given their low SES, the former had an increased likelihood of being under-represented in the selected sample.

Appendix B: Explanatory variable definitions

i) Maternal age group

Although discussions of late childbearing trends are becoming more common in the literature, its definition varies greatly. The age range used to differentiate "late" childbearing from "typical" may depend upon historical patterns of childbearing in a particular country or region, or may be an arbitrary decision based on availability of information. Three general definitions of late childbearing can be found in the literature: first birth at or after (i) age 30 (Heck et al., 1997), (ii) age 35 (Astolfi & Zonta, 2002; Garrison, Blalock, Zarski, & Merritt, 1997; Prysak et al., 1995), or (iii) age 40 (Ziadeh & Yahaya, 2001). Because the average age of women at childbirth in Canada is near 30, defining late childbearing as first birth at or after age 30 was deemed too early for the Canadian context. For the purposes of the present study, "late" or older maternal age was defined as a first birth occurring at or after age 35.

Women interviewed by the NLSCY were asked how old they were when they gave birth to their first child. This variable was used to classify women into five maternal age group categories: (i) women who were under age 20 when they had their first child (teenaged mothers); (ii) women who were ages 20 through 24 when they had their first child (young mothers); (iii) women who were ages 25 through 29 when they had their first child (reference mothers); (iv) women who were ages 30 through 34 when they had their first child (middle mothers); and (v) women who were age 35 and up when they had their first child (older mothers).

ii) Sociodemographic characteristics

Low household income (ages 0 to 1)
The household income variable used in this report is based on the ratio of self-reported pre-tax household income to the low-income cut-off (LICO) level as reported by Statistics Canada for the size and location of the child's household. LICOs are derived based on expenditure-to-income patterns, and are updated annually. LICO thresholds differ depending on family size and the region of residence (size of urban or rural centre) in which the family is located.

Using information available in the NLSCY, household income was dichotomized in analyses:
(0) not low-income (ratio of income to LICO was equal to or greater than 1).
(1) low-income (ratio of income to LICO was less than 1)

Low maternal educational attainment (ages 0 to 1)
Women reported the highest level of education that they had achieved. Responses were categorized in the following manner: less than high school education; high school degree or diploma; some post-secondary education; and college or university graduate (incl. trade schools).

Mothers' highest level of education was dichotomized in analyses:
(0) some post-secondary, college or university degree (including trade)
(1) less than secondary, secondary school graduation

Single-parent household (ages 0 to 1)
Single-parent households were those headed by the biological mother. Dual-parent households included the biological mother and the biological, step, foster or adoptive father. This variable was dichotomized in analyses:

(0) dual-parent household
(1) single-parent household

iii) Perinatal and postnatal measures

Each of these questions were asked of the mother during her first interview with the NLSCY, when the child was aged 0 to 1.

Method of delivery
Based on responses that women provided at their first interview, the method of birth delivery was dichotomized as:

(0) vaginal
(1) caesarean section

Gestational age
A series of questions were used to determine the child's gestational age in days.

i. "Was this child born before, after or on the due date?"
ii. If the child was not born on the due date, the mother was asked, "How many days before or after the due date was this child born?"

Based on these questions, gestational age was dichotomized as:

(0) term birth (259 days or more)
(1) preterm birth (258 days or less)

Birth weight
Based on maternal report of the child's birth weight in kilograms and grams, birth weight was dichotomized as:

(0) not low birth weight (2,500 grams at birth or more)
(1) low birth weight (2,499 grams or less at birth)

Duration of breastfeeding
At first interview, women were asked whether they had ever breastfed their child. For those who answered affirmatively, they were asked for how long the child was breastfed. Based on responses to these two questions, children were categorized into three groups: (1) those who were never breastfed, (2) those who were breastfed for 6 months or less, (3) those who were breastfed for more than 6 months.

Duration of breastfeeding was not assessed for children who were currently breastfed at the time of interview. In such cases, if the child was 7 months or older, their duration of breastfeeding was categorized as "more than 6 months". For children 0 to 6 months of age who were currently being breastfed at their last interview, duration of breastfeeding was categorized as unknown. To

maximize sample size in regression models, children whose duration of breastfeeding was unknown were included in the models, but the value of the regression estimate was not presented in tables.

iv) Parenting and family characteristics

Positive parenting practices scale (ages 2 to 3 and 4 to 5)
This scale is based on maternal responses to a set of five individual items. The mother was asked: "The following questions have to do with things that <your child> does and ways that you, as a parent, react to him/her." The questions were:

i. How often do you praise <your child> by saying something like "Good for you!" or "What a nice thing you did!" or "That's good going!"?
ii. How often do you and <your child> talk or play with each other, focusing attention on each other for five minutes or more, just for fun?
iii. How often do you and <your child> laugh together?
iv. How often do you do something special with <your child> that he/she enjoys?
v. How often do you play sports, hobbies or games with <your child>?

Response options were: (0) never, (1) about once a week or less, (2) a few times a week, (3) one or two times a day, and (4) many times each day. Scores were calculated for children ages 2 and over. Possible scores ranged from 0 to 20.

For children aged 2 to 3, the standardized, weighted Cronbach's alpha measure of internal reliability for the 5-item score was 0.65. For children aged 4 to 5, the measure of internal reliability was 0.68.

Ineffective parenting practices scale (ages 2 to 3 and 4 to 5)
This scale is based on maternal responses to a set of seven individual items. The mother was asked: "For the following questions, I would like you, as <your child>'s parent, to tell me how things go when you spend time with him/her." The questions were:

i. How often do you get annoyed with <your child> for saying or doing something he/she is not supposed to?
ii. Of all the times that you talk to <your child> about his/her behaviour, what proportion is praise?
iii. Of all the times that you talk to <your child> about his/her behaviour, what proportion is disapproval?
iv. How often do you get angry when you punish <your child>?
v. How often do you think that the kind of punishment you give <your child> depends on your mood?
vi. How often do you feel you are having problems managing <your child> in general?
vii. How often do you have to discipline <your child> repeatedly for the same thing?

Response options for the first item where: (0) never, (1) about once a week or less, (2) a few times a week, (3) one or two times a day, and (4) many times each day. Response options for

items ii through vii were: (0) never, (1) less than half the time, (2) about half the time, (3) more than half the time, and (4) all the time.[2] Possible scores ranged from 0 to 28. A high score indicates more hostile or ineffective interactions.

For children aged 2 to 3, the standardized, weighted Cronbach's alpha measure of internal reliability for the 7-item score was 0.67. For children aged 4 to 5, the measure of internal reliability was 0.69.

Family functioning scale (ages 2 to 3 and 4 to 5)
This scale is comprised of the 12-item General Functioning subscale of the McMaster Family Assessment Device (Epstein, Baldwin, & Bishop, 1983) and was used to provide a global assessment of family functioning and an indication of the quality of the relationships between parents or partners. The mother was asked: "The following statements are about families and family relationships. For each one, please indicate which response best describes your family." The statements were:

i. Planning family activities is difficult because we misunderstand each other
ii. In times of crisis we can turn to each other for support
iii. We cannot talk to each other about sadness we feel
iv. Individuals, in the family, are accepted for what they are
v. We avoid discussing our fears or concerns
vi. We express feelings to each other
vii. There are lots of bad feelings in our family
viii. We feel accepted for what we are
ix. Making decisions is a problem for our family
x. We are able to make decisions about how to solve problems
xi. We don't get along well together
xii. We confide in each other

Response options were: (0) strongly agree, (1) agree, (2) disagree or (3) strongly disagree. Responses to odd-numbered items were reverse-coded. Possible scores ranged from 0 to 36. A high score indicates greater family dysfunction.

For children aged 2 to 3, the standardized, weighted Cronbach's alpha measure of internal reliability for the 12-item score was 0.91. For children aged 4 to 5, the internal reliability measure was 0.92.

Mother's depressive symptoms scale (ages 2 to 3 and 4 to 5)
The NLSCY contains an adapted 12-item version of the Centre for Epidemiology Studies – Depression scale (CES-D). This scale is used to measure the occurrence and severity of symptoms associated with depression during the previous week. It is based on responses to a set of 12 individual items. The mother was asked: "The next set of statements describes feelings or behaviours. For each one, please tell me how often you felt or behaved this way during the past week." The statements were:

2. Response categories were reverse coded for item ii.

i. I did not feel like eating; my appetite was poor
ii. I felt that I could not shake off the blues even with help from my family or friends
iii. I had trouble keeping my mind on what I was doing
iv. I felt depressed
v. I felt that everything I did was an effort
vi. I felt hopeful about the future
vii. My sleep was restless
viii. I was happy
ix. I felt lonely
x. I enjoyed life
xi. I had crying spells
xii. I felt that people disliked me

Response options were: (0) rarely or none of the time (less than 1 day), (1) some or a little of the time (1 to 2 days), (2) occasionally or a moderate amount of time (3 to 4 days), and (3) most or all of the time (5 to 7 days). Responses to items vi, viii, and x were reverse-coded. Possible scores ranged from 0 to 36. A high score indicates the presence of depressive symptoms.

For children aged 2 to 3, the standardized, weighted Cronbach's alpha measure of internal reliability for the 12-item score was 0.78. For children aged 4 to 5, the internal reliability measure was 0.77.

Child was read to daily (ages 4 to 5)
Child was read to daily was based on the mother's response to the following question:

"How often do you (or your spouse): Read aloud to him/her or listen to him/her read or try to read?" The response options were: (i) rarely or never; (ii) a few times a month; (iii) once a week, (iv) a few times a week; or (v) daily.

In analyses, daily reading was dichotomized as:

(0) child was read to less often than daily (including *rarely or never, a few times a month, once a week, and a few times a week)*
(1) child was read to daily

Appendix C: Outcome variable definitions

i) Physical health and development

All physical health and development outcomes were based on mothers' reports.

Received special care at birth
For children aged 0 to 23 months, or if it was the first interview for the child, mothers were asked, "Did this child receive special medical care following his birth?".

(0) No
(1) Yes

For children who were reported as receiving special care at birth, mothers were asked what type of special care was received. Options were (i) intensive care, (ii) ventilation or oxygen, (iii) transfer to a specialized hospital, or (iv) other type of care. Mothers could report that their child received more than one type of specialized care. Mothers also indicated the number of days that their child was in this type of care following birth.

General health (ages 0 to 1, 2 to 3 and 4 to 5)
"In general, would you say this child's health is: (1) Excellent; (2) Very good; (3) Good; (4) Fair; (5) Poor"?

Responses to this question were dichotomized as:

(0) Good, Fair or Poor
(1) Excellent or Very good

Asthma (ages 0 to 1, 2 to 3 and 4 to 5)
"Has this child ever had asthma that was diagnosed by a health professional?"

(0) No
(1) Yes

Developmental milestones
Mothers were asked to report the age at which their child achieved each of five developmental milestones.

"The next questions ask when your child started to do certain things. If you do not know the exact age, your best estimate is fine." The questions were:

i. At what age (in months) did this child first sit themselves up?
ii. At what age (in months) did this child start eating solid food?
iii. At what age (in months) did this child start feeding themselves by picking up small pieces of food with their fingers and putting them in their mouth? This includes feeding him/herself a cracker or a cookie.
iv. At what age (in months) did this child take their first steps?

v. At what age (in months) did this child start saying their first words? By word I mean a sound or sounds a baby says consistently to mean someone or something such as 'baba' for 'bottle'.

All developmental milestone questions were asked for children aged 9 to 47 months at the time of interview, except for the question regarding first words which was limited to children aged 12 to 47 months at the time of interview.

Children above the 90th percentile were said to be late in achieving their developmental milestones. Due to the fact that PMKs reported their child's age at achieving milestones in whole months, the cut-points were rounded to the next highest whole number. The rounded cut-points for each milestone are as follows:

Late to sit up by self: age $\geq$ 8 months
Late to eat solid food: age $\geq$ 10 months
Late to feed self: age $\geq$ 13 months
Late to say first word: age $\geq$ 13 months
Late to take first step: age $\geq$ 14 months

Motor and Social Development scale

For children aged 0 to 3 years, mothers responded to a series of age-specific questions that were meant to measure children's gross and fine motor skills, perception and cognition, communication and language, and social development. The Motor Social Development (MSD) scale has been used in other national surveys such as the National Longitudinal Survey of Youth in the United States, and the National Child Development Survey in England.

Based on the child's age in months, mothers were asked whether their child had ever accomplished various tasks or behaviours. Fifteen items are used for each age range, as indicated in Table C.1.

The raw MSD score was standardized across age groups to have a mean of 100 with a standard deviation of 15. To facilitate comparison across cycles, the NLSCY produces a standardized score that uses the norms developed in the first cycle (1994/95) of the NLSCY. The standardized score was used in the present study.

Table C.1 Motor and Social Development (MSD) scale items by child's age in months

Motor and Social Development (MSD) items	Child's age in months							
	0 to 3	4 to 6	7 to 9	10 to 12	13 to 15	16 to 18	19 to 21	22 to 47
1. When lying on his stomach, has this child ever turned his head from side to side?	✓	...	...	...	...	...	...	...
2. Have his eyes ever followed a moving object?	✓	...	...	...	...	...	...	...
3. When lying on his stomach on a flat surface, has this child ever lifted his head off the surface for a moment?	✓	...	...	...	...	...	...	...
4. Have his eyes ever followed a moving object all the way from one side to the other?	✓	...	...	...	...	...	...	...
5. Has this child ever smiled at someone when that person talked to or smiled at (but did not touch) him?	✓	...	...	...	...	...	...	...
6. When lying on his stomach, has this child ever raised his head and chest from the surface while resting his weight on his lower arms or hands?	✓	...	...	...	...	...	...	...
7. Has this child ever turned his head around to look at something?	✓	...	...	...	...	...	...	...
8. When lying on his back and being pulled up to a sitting position, did this child ever hold his head stiffly so that it did not hang back as he was pulled up?	✓	✓	...	...	...	...	...	...
9. Has he ever laughed out loud without being tickled or touched?	✓	✓	...	...	...	...	...	...
10. Has he ever held in one hand a moderate sized object such as a block or a rattle?	✓	✓	...	...	...	...	...	...
11. Has he ever rolled over on his own on purpose?	✓	✓	...	...	...	...	...	...
12. Has this child ever seemed to enjoy looking in the mirror at himself?	✓	✓	✓	...	...	...	...	...
13. Has this child ever been pulled from a sitting to a standing position and supported his own weight with his legs stretched out?	✓	✓	✓	...	...	...	...	...
14. Has he ever looked around with his eyes for a toy which was lost or not nearby?	✓	✓	✓	...	...	...	...	...
15. Has he ever sat alone with no help except for leaning forward on his hands or with just a little help from someone else?	✓	✓	✓	...	...	...	...	...

Table C.1 Motor and Social Development (MSD) scale items by child's age in months

Motor and Social Development (MSD) items	Child's age in months							
	0 to 3	4 to 6	7 to 9	10 to 12	13 to 15	16 to 18	19 to 21	22 to 47
16. Has he ever sat for 10 minutes without any support at all?	...	✓	✓	...	...	...	...	...
17. Has he ever pulled himself to a standing position without help from another person?	...	✓	✓	...	...	...	...	...
18. Has this child ever crawled when left lying on his stomach?	...	✓	✓	✓	...	...	...	...
19. Has he ever said any recognizable words such as 'mama' or 'dada'?	...	✓	✓	✓	...	...	...	...
20. Has this child ever picked up small objects such as raisins or cookie crumbs, using only his thumb and first finger?	...	✓	✓	✓	...	...	...	...
21. Has he ever walked at least 2 steps with one hand held or holding on to something?	...	✓	✓	✓	...	...	...	...
22. Has this child ever waved good bye without help from another person?	...	✓	✓	✓	✓	...	...	...
23. Has he ever shown by his behaviour that he knows the names of common objects when somebody else names them out loud?	...	...	✓	✓	✓	...	...	...
24. Has he ever shown that he wanted something by pointing, pulling, or making pleasant sounds rather than crying or whining?	...	...	✓	✓	✓	...	...	...
25. Has he ever stood alone on his feet for 10 seconds or more without holding on to anything or another person?	...	...	✓	✓	✓	...	...	...
26. Has this child ever walked at least 2 steps without holding on to anything or another person?	...	...	✓	✓	✓	✓	...	...
27. Has he ever crawled up at least 2 stairs or steps?	...	...	...	✓	✓	✓	...	...
28. Has this child said 2 recognizable words besides 'mama' or 'dada'?	...	...	...	✓	✓	✓	...	...
29. Has this child ever run?	...	...	...	✓	✓	✓	✓	...
30. Has he ever said the name of a familiar object, such as a ball?	...	...	...	✓	✓	✓	✓	...
31. Has he ever made a line with a crayon or pencil?	...	...	...	✓	✓	✓	✓	...
32. Did he ever walk up at least 2 stairs with one hand held or holding the railing?	...	...	...	✓	✓	✓	✓	...
33. Has he ever fed himself with a spoon or fork without spilling much?	...	...	...	...	✓	✓	✓	...

Table C.1 Motor and Social Development (MSD) scale items by child's age in months

Motor and Social Development (MSD) items	Child's age in months							
	0 to 3	4 to 6	7 to 9	10 to 12	13 to 15	16 to 18	19 to 21	22 to 47
34. Has this child ever let someone know, without crying, that wearing wet (soiled) pants or diapers bothered him?	...	...	...	...	✓	✓	✓	✓
35. Has he ever spoken a partial sentence of 3 words or more?	...	...	...	...	✓	✓	✓	✓
36. Has he ever walked up stairs by himself without holding on to a rail?	...	...	...	...	✓	✓	✓	✓
37. Has he ever washed and dried his hands without any help except for turning the water on and off?	...	...	...	...	...	✓	✓	✓
38. Has he ever counted 3 objects correctly?	...	...	...	...	...	✓	✓	✓
39. Has he ever gone to the toilet alone?	...	...	...	...	...	✓	✓	✓
40. Has he ever walked upstairs by himself with no help, stepping on each step with only one foot?	...	...	...	...	...	✓	✓	✓
41. Does he know his own age and sex?	...	...	...	...	...	...	✓	✓
42. Has this child ever said the names of at least 4 colours?	...	...	...	...	...	...	✓	✓
43. Has this child ever pedalled a tricycle at least 10 feet?	...	...	...	...	...	...	✓	✓
44. Has this child ever done a somersault without help from anybody?	...	...	...	...	...	...	...	✓
45. Has this child ever dressed himself without any help except for tying shoes (and buttoning the backs of outfits)?	...	...	...	...	...	...	...	✓
46. Has this child ever said his first and last name together without someone's help? (Nickname may be used for first name.)	...	...	...	...	...	...	...	✓
47. Has this child ever counted out loud up to 10?	...	...	...	...	...	...	...	✓
48. Has this child ever drawn a picture of a man or woman with at least 2 parts of the body other than a head?	...	...	...	...	...	...	...	✓

... not applicable

ii) Problem and positive behaviours

All behavioural outcomes were based on mothers' reports.

Physical aggression scale
This scale is one of the components of the NLSCY's behaviour checklist. It is based on responses to a set of eight individual items for 2- to 3-year-olds and six items for 4- to 5-year-olds. Asked to indicate whether a specific behaviour was (0) never or not true, (1) sometimes or somewhat true, or (2) often or very true for their child, the child's mother was presented with the following example behaviours:

Table C.2 Physical aggression scale items by child's age in years

Physical aggression items	Ages 2 to 3	Ages 4 to 5
Is defiant?	✓	...
Gets into many fights?	✓	✓
Punishment doesn't change his behaviour?	✓	...
Has temper tantrums or hot temper?	✓	...
Doesn't seem to feel guilty after misbehaving?	✓	...
When somebody accidentally hurts him, he reacts with anger and fighting?	✓	✓
Has angry moods?	✓	...
Kicks, bites or hits other children?	✓	✓
Physically attacks people?	...	✓
Threatens people?	...	✓
Bullies or is mean to others?	...	✓

... not applicable

For 2- to 3-year-olds, the scale ranges from 0 to 16, with higher scores indicating the presence of greater physical aggression and opposition. The standardized, weighted Cronbach's alpha measure of internal reliability for the 8-item score for 2- to 3-year-olds was 0.70.

For 4- to 5-year-olds, the scale ranges from 0 to 12, with higher scores indicating the presence of greater physical aggression and conduct disorder. The standardized, weighted Cronbach's alpha measure of internal reliability for the 6-item score for 4- to 5-year-olds was 0.76.

Hyperactivity and inattention scale
This scale is one of the components of the NLSCY's behaviour checklist. It is based on responses to a set of six individual items for 2- to 3-year-olds, and seven items for 4- to 5-year-olds. Asked to indicate whether a specific behaviour was (0) never or not true, (1) sometimes or somewhat true, or (2) often or very true for their child, the child's mother was presented with the following example behaviours:

Table C.3 Hyperactivity and inattention scale items by child's age in years

Hyperactivity and inattention items	Ages 2 to 3	Ages 4 to 5
Can't sit still or is restless?	✓	✓
Is easily distracted, has trouble sticking to any activity?	✓	✓
Can't concentrate, can't pay attention for long?	✓	✓
Is impulsive, acts without thinking?	...	✓
Can not settle on anything for more than a few moments?	✓	✓
Has difficulty waiting for his turn in games or groups?	✓	✓
Is inattentive?	✓	✓

... not applicable

For 2- to 3-year-olds, possible scores ranged from 0 to 12, with a higher score indicating the presence of greater hyperactivity and inattention. The standardized, weighted Cronbach's alpha measure of internal reliability for the 6-item score for 2- to 3-year-olds was 0.69.

For 4- to 5-year-olds, possible scores ranged from 0 to 14, with a higher score indicating the presence of greater hyperactivity and inattention. The standardized, weighted Cronbach's alpha measure of internal reliability for the 7-item score for 4- to 5-year-olds was 0.78.

Emotional disorder and anxiety scale

This scale is one of the components of the NLSCY's behaviour checklist. It is based on responses to a set of six individual items for 2- to 3- year-olds and seven items for 4- to 5-year-olds. Asked to indicate whether a specific behaviour was (0) never or not true, (1) sometimes or somewhat true, or (2) often or very true for their child, the child's mother was presented with the following example behaviours:

Table C.4 Emotional disorder and anxiety scale items by child's age in years

Emotional disorder and anxiety items	Ages 2 to 3	Ages 4 to 5
Seems to be unhappy or sad?	✓	✓
Is not as happy as other children?	✓	✓
Is too fearful or nervous?	✓	✓
Is worried?	✓	✓
Is nervous, high strung or tense?	✓	✓
Has trouble enjoying himself/herself?	✓	✓
Cries a lot?	...	✓

... not applicable

For 2- to 3-year-olds, possible scores ranged from 0 to 12, with a higher score indicating the presence of greater emotional disorder and anxiety. The standardized, weighted Cronbach's alpha measure of internal reliability for the 6-item score for 2- to 3-year-olds was 0.64.

For 4- to 5-year-olds, possible scores ranged from 0 to 14, with a higher score indicating the presence of greater emotional disorder and anxiety. The standardized, weighted Cronbach's alpha measure of internal reliability for the 7-item score for 4- to 5-year-olds was 0.67.

Positive behaviour scale (ages 4 to 5)
This scale is made up of six items from the Positive Behaviour checklist to assess positive behaviour of children aged 3 to 5, including perseverance and independence. The mother was asked: "For the next set of questions, please think about <your child>'s behaviour over the past month or two. How often does <your child>:

i. Keep his/her temper?
ii. Listen well and pay attention?
iii. Show self-control?
iv. Finish things he/she starts?
v. Persist with solving a problem, even when things go wrong for a while?
vi. Make an effort to do something, even if he/she doesn't feel confident about it?"

Response options were: (0) never, (1) sometimes or (2) often. Possible scores ranged from 0 to 12. A high score indicates greater perseverance and independence.

The standardized, weighted Cronbach's alpha measure of internal reliability for the 6-item score was 0.69.

iii) Cognitive development

All measures of cognitive development are direct assessments of the child.

Receptive vocabulary score
The measure of receptive vocabulary was the standard score on the Peabody Picture Vocabulary Test – Revised (PPVT-R). Scores had a mean value of 100 and a standard deviation of 15. More information about the PPVT-R in the NLSCY may be found in the *Microdata User Guide* for the NLSCY for cycle 6, page 141-143 (Statistics Canada).

Number knowledge score
The measure of number knowledge was the age-standardized score on the 22-question (30-item) Number Knowledge Assessment instrument. Scores had a mean value of 100 and a standard deviation of 15. More information about the Number Knowledge Assessment instrument in the NLSCY may be found in the *Microdata User Guide* for the NLSCY for cycle 6, page 143-145 (Statistics Canada).

Copying and symbol use score
The measure of copying and symbol use was the standard score on *Who Am I?*, an instrument that evaluates the developmental level of young children (DeLemos, 2002). Scores had a mean value of 100 and a standard deviation of 15. More information about the copying and symbol use instrument in the NLSCY may be found in the *Microdata User Guide* for the NLSCY for cycle 6, page 145-147 (Statistics Canada).